NEWFOUNDLAND AND LABRADOR

DEPARTMENT OF ENVIRONMENT

HYDROGEOLOGY
OF
TRINITY BAY AREA
21809

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Department of Environment

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St. John's Newfoundland

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NOTATIONS

Metric			English		
^{o}C	-	degrees Celsius	^{o}F	-	degrees Farenheit
mm	-	millimetre	in	-	inch
cm	-	centimetre			
cm^2	-	square centimetre	in^2	-	square inch
m	-	metre	ft	-	feet
km	-	kilometre	mi	-	mile
km^2	-	square kilometre	mi^2	-	square mile
lpm	-	litre per minute	gpm	-	gallon per minute*
cm/sec	-	centimetre per second	ft/sec	-	feet per second
mm/yr	-	millimetre per year	in/yr	-	inches per year
mg/l	-	milligrams per litre	ppb	-	part per billion
mg/g	-	microgram per gram			

MISCELLANEOUS

% - percent

Drillers

01 - Dynamic Drilling Company Limited
02 - J. Goodyear and Sons Limited
03 - Lewis A. Potter
04 - Martin B. Hammond Company Limited
05 - P. Sullivan and Sons Company Limited
08 - Evangeline Well Drillers
09 - Elmore Uhlman

* All values are assumed to be in Imperial gallons

ABSTRACT

This report compiles, summarizes and interprets all the readily available data on the ground water resources of the Trinity Bay area and has also resulted in the preparation of three accompanying maps outlining the hydrogeologic resources.

Dug wells make the most extensive use of the ground water resource within the study area although no information presently exists on the numbers or distribution of such wells. Based on qualitative information, the glaciofluvial sands and gravels which comprise Surficial Hydrostratigraphic Unit - S2, are considered to have the best ground water yield. Potentially large yields are available if wells were properly constructed and developed within this unit.

Over 60% of the bedrock wells have been drilled within Hydrostratigraphic Unit 4; it consists of the Hodgewater Group sedimentary sequence. This unit is the most productive bedrock hydrostratigraphic unit in the Trinity Bay area and is predominantly found within the Carbonear Peninsula. Most wells have been drilled on the densely populated western side of Conception Bay. Most hydrostratigraphic units can meet all domestic supply requirements, however non-domestic needs can less readily be supplied.

Based on mean monthly hydrograph records for the Pipers Hole and Come by Chance River basins, values of 178 and 106 mm respectively for ground water recharge over the drainage basin have been calculated. For all three hydrometric stations in the Trinity Bay area, low discharge values in winter and high discharge values in the summer have been noted - a reversal of the "normal" pattern.

Most of the ground water quality data pertains to Hydrostratigraphic Unit 4 and suggests that fair to good quality ground water can be expected. Excessive manganese values represent the biggest problem while elevated chloride and trace metal values are occasionally recognized. Considerably less data exists for other geologic/hydrostratigraphic units in the study area.

In the Trinity Bay area, poor well construction represents the most common contributing factor to contamination problems.

1 INTRODUCTION

The firm of Nolan, Davis & Associates was engaged by the Province of Newfoundland and Labrador under the direction of the Department of Environment, to study and prepare a report on the hydrogeologic characteristics of the Trinity Bay area.

This publication is the fourth in the Department of Environment's Water Resources - Groundwater Series. It continues the efforts of the Water Resources Division to compile, interpret and subsequently better understand the hydrogeologic resources of the province thus enabling better management of these resources in the province.

1.1 Scope of Study

The hydrogeological study of the Trinity Bay area was conducted within the guidelines provided by the Department of Environment. The study objectives were to determine the physical characteristics of the major geologic units in relation to the occurrence, quantity and quality of the constituent ground water. To meet these objectives the following steps were undertaken:

a) the physiography, surficial geology and bedrock geology were described.

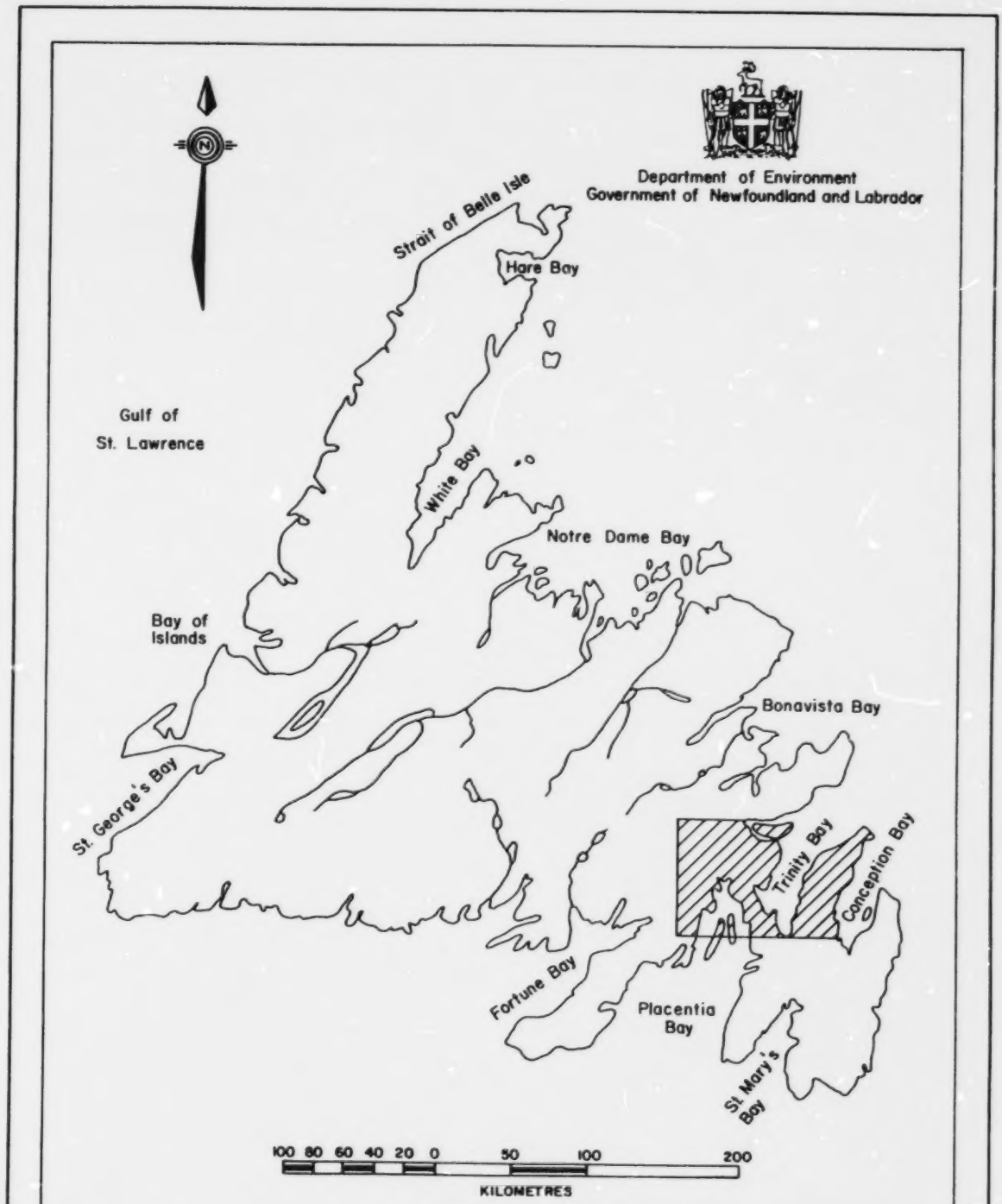
b) pertinent reports, drilled well records and previous experience within the study area were used to define and characterize the hydrogeological potential of the surficial and bedrock units

c) hydrologic data, for three gauged streams, was examined to assess and quantify ground water recharge

d) three maps, at a scale of 1:250,000, were prepared; they detail the bedrock geology, surficial hydrogeology and bedrock hydrogeology.

1.2 Location

Located on the east coast of the island of Newfoundland, the study area is both westward of and along the northwestern portion of the Avalon Peninsula (see Figure 1-1); it surrounds Trinity Bay on three sides. The northern boundary of the Trinity Bay study area which coincides with the Bonavista Bay study area, lies northward of Random Island and bisects Smith Sound. The boundary then runs along the latitude $48^{o}14'$ to the $54^{o}30'$ longitude. The western boundary of the study area is defined by the $54^{o}30'$ longitude which continues southward until it intersects the $47^{o}30'$ latitude in the area of Placentia Bay. The $47^{o}30'$ latitude eastward to Conception Bay forms the southern boundary. It includes most of Merasheen and Long Islands within Placentia Bay (see Figure 1-2).



HYDROGEOLOGY OF TRINITY BAY AREA

Figure 1-1

Location plan of study area

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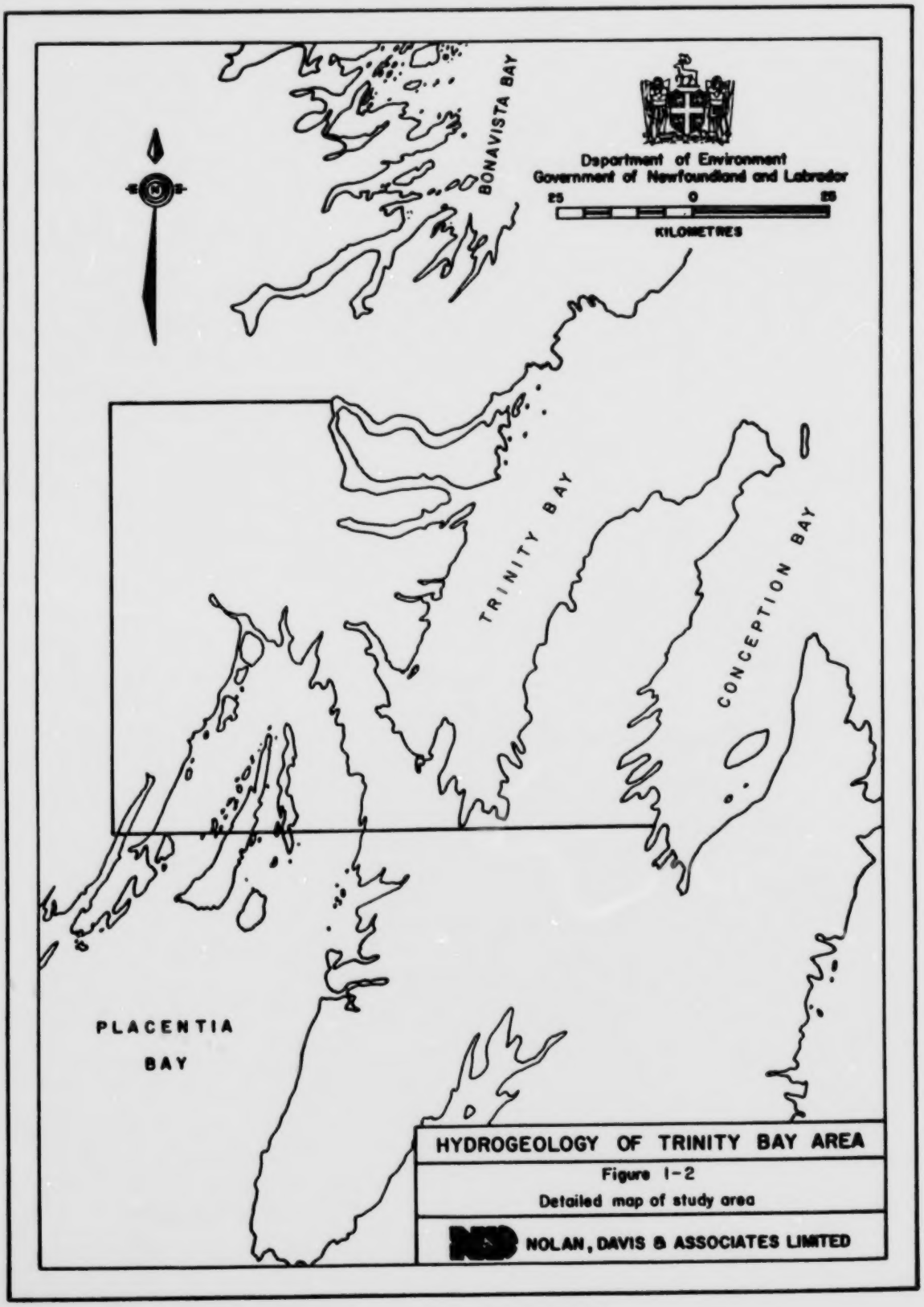
BONAVISTA BAY
Department of Environment
Government of Newfoundland and Labrador
25 0 25
KILOMETRES
TRINITY BAY
CONCEPTION BAY
PLACENTIA
BAY
HYDROGEOLOGY OF TRINITY BAY AREA
Figure 1-2
Detailed map of study area
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The study area includes all of the Carbonear, Harbour Grace, Trinity-Bay de Verde and portions of the Placentia East and West, Trinity North and South, and Port de Grave electorial districts. It is covered either entirely or partially by the following 1:250,000 and 1:50,000 National Topographic System maps.

1:250,000	-	2C	
		2D	
		1M	
		1N	
1:50,000	-	2C	2/3/4
		2D	1
		1M	9/16
		1N	11/12/13/14

1.3 Population and Economy

Within the Trinity Bay area, Statistics Canada has estimated a total population of 59,768, based on 1981 interim census data. Over 70% of this population is distributed in small communities that range in population size from 243 to 5,279; most communities have fewer than 1,000 people. Table 1-1 lists the population centers within the Trinity Bay study area. The largest centers include Carbonear, Bay Roberts and Harbour Grace which are all located on the west coast of Conception Bay. In all cases, the large and small population centers are located along the coast.

As in many areas of Newfoundland and Labrador, the

TABLE 1-1

POPULATION CENTERS

Arnolds Cove	1,115
Bay de Verde	779
Bay Roberts	4,455
Bishops Cove	364
Brigus	889
Bryants Cove	377
Carbonear	5,279
Chance Cove	494
Chapel Arm	680
Clarenville	2,848
Clarkes Beach	999
Come by Chance	335
Cupids	701
Freshwater	1,265
Hants Harbour	537
Harbour Grace	2,961
Harbour Grace South	359
Hearts Content	617
Hearts Delight-Islington	892
Hearts Desire	412
New Perlican	347
Normans Cove-Long Cove	1,143
North River	243
Old Perlican	704
Riverhead	428
Salmon Cove	779
Shoal Harbour	992
Small Point-Broad Cove-Blackhead-Adams Cove	535
South River	637
Southern Harbour	759
Spaniards Bay	2,108
Sunnyside	697
Swift Current	875
Tilton	569
Upper Island Cove	2,009
Victoria	1,853
Whiteway	289
Winterton	743
Total	42,078

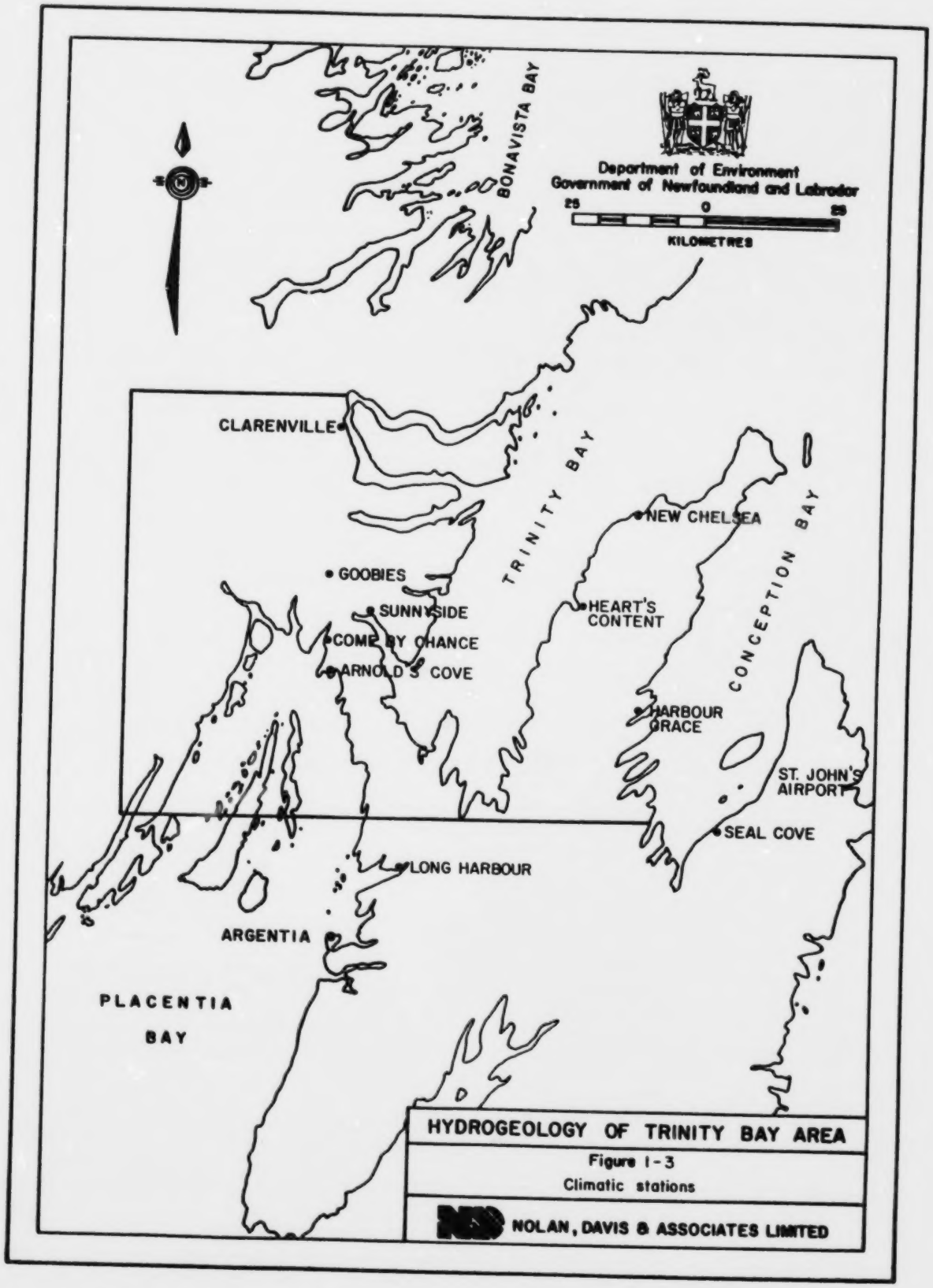
economic base within the Trinity Bay area is maintained by the fishing industry; encompassing both the inshore and offshore fishery, ship construction and repair, and related supply industries. Acitivity within the forest industry is related to supply of raw materials for the pulp and paper industry. Manufacturing industries producing brick, from local materials; and footwear, utilizing a locally skilled labour force; are located within the study area. The petrochemical complex at Come by Chance offers potential for a further economic benefit to the area. Seasonally, the tourism industry is also important within the study area.

1.4 Climate

1.4.1 Introduction:

The climate of the Trinity Bay study area can be considered as marine, due to the overwhelming influence of the Atlantic Ocean on all regions. Cool temperatures and moderately high total precipitation, characterize this and many other areas of Eastern Newfoundland.

Although eight climatic stations are positioned within the study area (see Figure 1-3), the period of record for most of these stations is less than ten years, some are considerably shorter. Substantially longer periods of record exist for the three major stations located at St. John's


BONAVISTA BAY
Department of Environment
Government of Newfoundland and Labrador
25 0 25
KILOMETRES
CLARENVILLE
TRINITY BAY
NEW CHELSEA
CONCEPTION BAY
GOOBIES
SUNNYSIDE
HEART'S CONTENT
COME BY CHANCE
ARNOLD'S COVE
HARBOUR GRACE
ST. JOHN'S AIRPORT
SEAL COVE
LONG HARBOUR
ARGENTIA
PLACENTIA BAY
HYDROGEOLOGY OF TRINITY BAY AREA
Figure 1-3
Climatic stations
NOLAN, DAVIS & ASSOCIATES LIMITED

Airport, Gander Airport and Argentia - located east, northwest and south, respectively, of the study area. All these stations have both mean daily temperature and mean monthly total precipitation data. Evaporation pan data is available for the Gander Airport and St. John's Airport stations.

The Gander Airport station, though well outside the Trinity Bay area, was used because it has a long period of high quality data. In addition, its geographic position near the headwaters of a major river system within the study area (Pipers Hole River), is probably more representative of climatic conditions than the more southerly Argentia station. However, the extent to which climatic conditions will differ, between the Gander climatic station and the Pipers Hole River and Come by Chance River gauging stations, are not known. According to Peach (1975) "... conditions along all major coasts of both the Island of Newfoundland and Labrador are frequently vastly different than at localities only a short distance inland". Consequently, to facilitate the use of the longer period of record, a double mass curve technique was employed. This technique extrapolated the Gander station data to the climatic stations, with shorter periods of record, in the vicinity of the gauging stations.

1.4.2 Temperature:

Monthly summaries of mean daily temperature data

were available for all stations (see Table 1-2). Within the Trinity Bay study area, these mean daily temperatures, for the period of record, range from -7.2 to 17.4°C (19.0 to 63.3°F). The annual mean monthly temperature ranges from 4.2 to 5.5°C (39.6 to 41.9°F). The lowest recorded monthly mean daily temperature was -11.3°C (11.7°F) in February of 1975 at Sunnyside; the highest was 18.9°C (66.0°F), it was recorded in 1967 at New Chelsea. Sub-zero temperatures generally prevail in December, January, February and March throughout the Trinity Bay area while near zero temperatures prevail in April. July, August and September are the warmest months, the highest temperatures almost always occurring in August.

1.4.3 Precipitation:

Summaries of the monthly total precipitation data are arranged in Table 1-3, for the period of record of each station considered in this study. For stations within the study area, the mean monthly total precipitation ranges from 33.8 to 239.3 mm (1.3 to 9.4 in); annual total precipitation ranges from 1 153.5 to 1 645.5 mm (45.4 to 64.8 in). Considering the entire period of record for study area stations, the lowest monthly value, 11.2 mm (0.4 in), was recorded in July, 1972 at Hearts Content; the highest monthly value, 324.4 mm (12.8 in), was obtained in August, 1970 at the New

TABLE 1-2

MONTHLY MEAN DAILY TEMPERATURE (^{o}C)

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	MEAN ANNUAL	DURATION
Argentia A	-1.9	-2.4	-0.7	2.2	5.6	9.3	13.9	15.4	12.7	8.5	5.1	0.7	5.7	1945-1970
Argentia VIMS	-1.7	-3.6	-0.6	2.0	5.4	10.1	13.7	14.9	12.3	8.5	4.3	-0.5	5.4	1976-1980
Arnolds Cove	-4.1	-5.2	-1.9	2.1	5.4	9.5	13.9	15.2	12.8	7.7	3.5	-1.7	4.8	1971-1980
Clarenville	-3.5	-5.2	-1.9	2.1	7.2	12.9	16.2	15.5	11.5	7.0	2.4	-2.8	5.1	1978-1980
Come by Chance	-3.6	-5.1	-1.7	2.1	5.8	9.8	14.0	15.1	12.1	7.2	3.3	-1.8	4.8	1968-1980
Goobies	-4.2	-7.2	-1.1	2.5	6.5	11.6	14.3	14.8	10.7	6.8	2.1	-3.4	4.5	1978-1980
Gander Airport	-6.5	-7	-3.7	0.8	6.3	11.6	16.6	15.7	11.7	6.2	1.6	-3.7	4.2	1937-1980
Harbour Grace	-3.8	-4.2	-1.7	2.6	5.7	12.0	14.5	17.4	12.1	7.3	3.8	-0.9	5.4	1979-1980
Hearts Content	-3.8	-4.2	-1.3	2.1	6.4	11.4	15.9	16.0	12.4	7.8	4.0	-0.8	5.5	1962-1980
Long Harbour	-3.6	-4.2	-0.7	2.6	6.3	10.7	15.1	15.7	12.5	8.4	4.4	-0.6	5.6	1969-1980
New Chelsea	-3.5	-3.9	-1.3	1.9	6.0	11.2	15.7	15.6	12.3	7.9	4.1	-0.8	5.4	1962-1980
St. John's Airport	-4.1	-4.7	-2.4	1.1	5.5	10.6	15.4	15.3	11.8	7.0	3.3	-1.6	4.8	1942-1980
Seal Cove	-3.4	-3.5	-0.7	2.6	6.8	12.2	16.6	16.2	12.5	8.1	4.3	-0.5	5.9	1962-1980
Sunnyside	-5.6	-6.4	-2.7	1.7	5.4	10.3	14.3	15.0	11.8	6.8	2.4	-3.1	4.2	1971-1980

TABLE 1-3

MEAN MONTHLY TOTAL PRECIPITATION (mm)

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	MEAN ANNUAL	DURATION
Argentia A	118.2	110.2	74.7	70.8	66.5	72.2	79.5	84.7	80.6	86.0	105.4	108.5	1057.3	1945-1970
Argentia VIMS	131.0	64.4	106.5	72.3	99.7	112.5	95.4	107.1	147.4	156.0	108.2	147.8	1348.3	1976-1980
Arnolds Cove	134.8	88.0	102.6	68.7	88.0	97.0	83.5	100.0	97.0	150.2	126.0	129.7	1265.5	1971-1980
Clarenville	104.0	65.0	107.3	50.6	82.6	56.7	100.8	108.3	147.7	137.4	128.8	100.3	1189.8	1978-1980
Come by Chance	121.9	73.2	107.3	87.6	77.8	97.8	73.0	97.0	89.9	123.4	85.0	124.9	1158.8	1968-1980
Gander Airport	96.3	94.5	95.3	83.0	68.5	77.3	76.2	95.3	85.0	104.7	109.9	103.8	1089.8*	1937-1980
Goobies	91.5	70.5	108.2	44.3	112.5	78.1	124.5	106.0	94.2	173.4	105.4	74.7	1183.3	1978-1980
Harbour Grace	126.6	120.4	173.5	33.8	106.6	90.4	69.2	186.2	220.0	239.3	153.5	126.0	1645.5	1979-1980
Hearts Content	107.5	93.9	93.7	78.0	81.1	80.4	72.7	114.9	95.4	121.6	105.4	108.9	1153.5	1961-1980
Long Harbour	122.9	102.2	103.4	85.2	94.2	94.9	75.7	133.9	122.2	169.8	123.7	121.0	1349.3	1969-1980
New Chelsea	121.1	101.0	99.1	79.2	83.4	81.2	62.6	107.5	95.0	127.6	120.5	114.9	1193.1	1961-1980
St. John's Airport	149.5	145.5	129.2	113.9	98.5	89.3	82.1	116.4	118.2	145.0	157.2	163.5	1508.3	1942-1980
Seal Cove	133.6	112.9	113.1	85.7	75.7	74.7	68.3	111.9	93.2	128.8	121.2	129.2	1248.3	1961-1980
Sunnyside	98.0	84.4	97.2	82.0	97.7	106.6	88.5	105.4	109.2	150.3	118.7	111.7	1139.7	1971-1980

* estimated value

Chelsea station. For stations within the study area, the months with the most precipitation are usually October, December, January and March. Consistently, April has the lowest mean monthly total precipitation values while July, June or less frequently May, also have low values. Most stations in the Trinity Bay study area, are on or near the coast and all receive in excess of 1100 mm (43.3 in) of annual total precipitation.

1.4.4 Evapotranspiration:

Evapotranspiration measures the amount of moisture lost to the atmosphere by evaporation from surface water bodies, soil surfaces, and from the soil by plant transpiration. It's importance is associated with the water balance equation and in establishing quantitative estimates of ground water recharge. Usually, evapotranspiration is reported as either potential or actual evapotranspiration. Both are based on theoretical calculations of the amount of moisture that could be lost given ideal conditions. Environment Canada has calculated evapotranspiration data available for the New Chelsea station within the study area, as well as the St. John's Airport, Gander Airport and Seal Cove stations outside the study area.

The potential and actual evapotranspiration values are both calculated using the method developed by Thornthwaite

(1948). The data presented assumes that 100 mm (25.4 in) of soil moisture is available for evapotranspiration. Table 1-4 presents the calculated evapotranspiration data. It indicates that evapotranspiration, within the Trinity Bay area, exceeds this 100 mm value by 1 - 23 mm (0.04 - 0.9 in) during the months of July and August.

Calculated lake evaporation data, based on the use of evaporation pans, is presented for the Gander Airport and St. John's Airport stations. In humid areas the use of the Thornthwaite method is less reliable for calculating evapotranspiration. This fact has a considerable effect on the solution of the water balance equation. Table 1-4 presents the available data and illustrates differences of 3 - 27.3 mm (0.1 - 1.1 in) between the theoretical evapotranspiration and lake evaporation data. The differences indicate that substantially more evapotranspiration actually occurs during June, while significantly reduced values occur during August, September and October, compared to the theoretical evapotranspiration values.

1.5 Previous Work

Presently hydrogeologic work within the Trinity Bay study area is limited to site specific investigations. Additional hydrogeological information, of a general nature,

TABLE 1-4

EVAPOTRANSPIRATION AND LAKE EVAPORATION (mm)

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
Argentia Airport													
Potential	0	0	0	17	50	80	111	112	80	50	30	6	535
Actual	0	0	0	17	50	80	105	100	80	50	30	6	517
Gander Airport													
Potential	0	0	0	9	50	80	122	122	80	43	24	9	518
Actual	0	0	0	9	50	80	115	112	80	43	24	0	512
Mean Calculated Lake Evaporation	-	-	-	-	-	104.9	112.0	94.2	63.3	22.0	-	-	
New Chelsea													
Potential	0	0	0	17	60	91	123	112	80	50	23	0	557
Actual	0	0	0	17	60	91	105	112	80	50	23	0	539
Seal Cove													
Potential	0	0	0	17	50	91	122	112	72	43	24	0	529
Actual	0	0	0	17	50	88	101	111	72	43	24	0	505
St. John's Airport													
Potential	0	0	0	9	50	80	122	112	80	43	24	0	518
Actual	0	0	0	9	50	80	115	112	80	43	24	0	512
Mean Calculated Lake Evaporation	-	-	-	-	-	100.4	126.8	96.8	79.3	-	-	-	

NOTE: Potential and actual evaporation calculations assume 100 mm of soil moisture.

was provided in "Water Resources Study of the Province of Newfoundland and Labrador", by Shawinigan Engineering Limited and James F. MacLaren Limited (1968). The information contained within the Water Resources Division 1979 publication - "Water Well Data for Newfoundland 1950 - 1977" and additional well records from their files, provided the basis for the hydrogeological characterization of the Trinity Bay area. To a limited extent, well logs produced since 1977 were incorporated in the study. From site specific investigations, a considerable volume of data was available from Nolan, Davis & Associates.

Reports, information and maps, from the Newfoundland and Labrador - Department of Mines and Energy and the Geological Survey of Canada, provided the basis for development of the surficial and bedrock geology maps of the study area. Hydrometric and climatic data for the Trinity Bay area, was obtained from Environment Canada - the Water Survey of Canada and Atmospheric Environment Service respectively.

1.6 Acknowledgements

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supervision of F. Nolan; H. LeBlanc acted as chief investigator. R. Cottingham and F. Baechler were individually responsible for writing important sections and coordinating work on the report. F. Nolan and B. Davis provided specific information on the geology and hydrogeologic characteristics within the study area. Maps, drawings and graphs were prepared and drafted by F. Garland. K. Garden-Rushton was responsible for technical support, typing, and greatly assisted in compilation and organization of the report. The assistance of Messrs. W. and R. Byers was greatly appreciated in characterizing the hydrologic features of the study area.

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2 PHYSIOGRAPHY

2.1 Topography and Terrain

Although the physiography of the Trinity Bay area has not been extensively described in the literature, there have been a number of descriptions of specific areas having geological interest and some brief discussion of broader areas which have accompanied geological map sheets.

In 1940, Snelgrove published a map depicting 12 physiographic divisions on the island of Newfoundland. Two such divisions are found within the Trinity Bay study area:

a) the Atlantic Upland

b) the Trinity Bay Lowland

In the same year the most comprehensive paper on the physiography of the island of Newfoundland was published by Twenhofel and MacClintok (1940). Jenness (1963), MacCartney

(1967) and Henderson (1972), of the Geological Survey of Canada, each described aspects of the physiography of the study area in their respective reports. More recently, some features were discussed in the areas of southern Conception and northern St. Mary's Bays by Bruckner (1979).

Two major peneplane surfaces were identified by Twenhofel and MacClintok (1940) within the island of Newfoundland. These old erosion surfaces are tilted slightly downward to the east, with minimum elevations in the Avalon region. The Upland surfaces of the High Valley Peneplane reach elevations of 213 m - 244 m (700 - 800 ft) above sea level; whereas the Lawrence Peneplane in the Avalon region is represented by rolling topography and elevations of 107 - 152 m (350 - 500 ft). Isolated monadnocks within the area exceed elevations of 305 m (1000 ft), the highest located at Center Hill, 345 m (1133 ft).

The coastal lowlands (Snelgrove's Trinity Bay Lowland) are underlain by younger Paleozoic sedimentary rocks which are more susceptible to erosion. The most extensive lowland area can be found along the east coast of Trinity Bay, from Hearts Desire southward to South Dildo; thence extending southward through the Whitbourne area, to St. Mary's Bay. The less resistent sedimentary strata which underlie this area, were evidently more susceptible to scour from the

Avalon ice sheet, resulting in elevations which are presently less than 91 m (300 ft).

The topographic features of the Trinity Bay area have been influenced mainly by the bedrock geology. Glaciation and surficial deposits, have also contributed to the creation of present day land forms. The most prominent trend for the alignment of ridges, valleys and embayments is northeast or north-northeast, the typical Appalachian trend. Fold axes and faults are more prominent in these directions. Secondary structural features, such as joint planes oriented in other directions, have likewise contributed to patterns which have emerged within the area. What is most apparent upon observing maps of the area, is the parallelism of features such as embayments.

2.2 Drainage

Numerous ponds and small lakes abound throughout the study area. Most are situated on the higher plateaus within the headwaters of the many small streams. These streams flow in irregular patterns in the highlands, but upon reaching the coastal lowlands or valleys, they flow directly into the sea. The streams tend to be clear with little sediment load, thus explaining the absence of modern alluvial deposits. On some of the interior plateaus relief is slight

and drainage is poor, as is evidenced by the presence of numerous bogs.

3 GEOLOGY

3.1 Surficial Geology

The entire study area was influenced by the Wisconsin glaciation during the Pleistocene Epoch. It is generally believed that ice radiating from the St. Mary's Bay region covered the Carbonear Peninsula, while the western portion of the study area was glaciated by ice which flowed east and southeast from the Newfoundland interior. Central parts of the Isthmus of Avalon, which connects the two zones, were apparently covered at different times by ice from each source.

As a result of late Pleistocene glaciation, most of the study area is covered by thin, discontinuous Quaternary deposits, interrupted by outcrops or large areas of exposed bedrock (see Surficial Hydrogeology - Map 2). In terms of areal extent, the most noteworthy bedrock exposures occur:

a) on the eastern half of Random Island

b) across most of the small peninsula which separates Northwest Arm and Southwest Arm

c) in highland areas west of Northwest Brook and inland from the coast of Western Channel

d) in the escarpment area of the central Carbonear Peninsula north of Victoria

e) in the rugged coastal belt between Random Sound and the southern part of the Isthmus of Avalon.

The most predominant Quarternary deposit found throughout the Trinity Bay study area is ground moraine. Typically, it is essentially comprised of heterogenous till, although stratified drift may occur randomly. Deposits laid down or reworked by meltwater - such as outwash sand and gravel, eskers, kames, etc., are sparse and/or lacking in many areas. Many of these larger deposits are located close to or extend into the sea. According to Henderson (1972), their small onland volume signifies that most have been swept into the larger basins that penetrate the coastal areas.

3.1.1 Ground Moraine:

As mentioned previously, the most prevalent unconsolidated deposit found within the study area is a rather discontinuous stratum of ground moraine. Typically, this layer is relatively thin, rarely exceeding a thickness of 10 m (33 ft) and very often consists of a slight veneer over bedrock. The moraine is often confined to valleys between numerous bedrock ridges. Where it forms a continuous or

near-continuous cover, the surface of the moraine generally reflects changes in bedrock relief. Vanderveer (1977) identified an area north of Sunnyside, characterized by abundant drumlinoid and linear flow features, which serve to identify fairly thick deposits of ground moraine. In addition, he confirmed that thicker deposits occur as till ramps or as tails, in bedrock controlled crag and tail situations.

The till comprising the ground moraine, most often reflects the nature of the underlying bedrock formations. Since much of the area is underlain by granitic rocks, durable sandstones and well-cemented conglomerates, the ground moraine typically consists of a coarse, granular sandy till with a low silt and clay content. In addition, due to the high resistance to abrasion of large particles, cobble and boulder constituents are typically angular or, at best, slightly rounded. Limited transport distances of these particles has undoubtedly contributed to their lack of wear and thus the maintenance of their angularity. Henderson (1972) noted that the typical grain-size distribution of the till in one particular oriented till ridge, located north of Little Southern Harbour, is characterized by an unusually high silt and clay content of 35 percent.

Data from Nolan, Davis & Associates geotechnical projects generally confirm that the till is coarse-grained.

It can usually be described geotechnically as a sand and gravel mixture with varying percentages of angular cobbles and boulders. Sieve analyses, from the forementioned source, indicate the percentage of gravel (4.75 - 76.2 mm or 0.19 - 3 in) present in the samples ranges from 15 to 60%, sand (0.75 - 4.75 mm or 0.03 - 0.19 in) from 18 to 65%, while the content of silt and clay (0.002 - 0.075 mm or 7.9×10^{-5} - 0.03 in) present in the samples ranges from 5 to 40 percent. Included in the above summary, are test results on samples recovered from a till deposit in Arnolds Cove which displayed inordinately high silt and clay contents (26 - 40%).

A portion of the end moraine which separates the inner and outer drift zones in eastern Newfoundland, lies within the Trinity Bay study area. While this deposit is one of the most important in the region (due to its usefulness in the interpretation of regional glacial history), it is generally inconspicuous on the ground. According to Jenness (1963), it can be recognized either where glacial outwash deposits describe a radial pattern or through the presence of small boulder strewn hills and hillocks. In many instances, granitic rocks lie immediately to the west of these hillocks, thus accounting for the coarse nature of the material. Where the internal composition of the end moraine is exposed, granitic boulders - as much as 6 m (20 ft) in diameter, are

seen piled in small hillocks combined with finer size material, all unsorted and unstratified.

3.1.2 Glaciofluvial Deposits:

Only a very small percentage of the study area is covered by glaciofluvial deposits such as eskers, kames, kame terraces and outwash sediments. Furthermore, deposits of this nature almost exclusively lie adjacent to the sea. Henderson (1972) hypothesizes that this distribution can be explained if much of the meltwater carried little sediment and eroded rather than deposited the material.

3.1.3 Eskers:

A few small eskers lie within the Trinity Bay study area and all are found inland. They are located west of the end moraine which separates eastern Newfoundland's inner and outer drift zones.

3.1.4 Crevasse Fillings:

Henderson (1972) has identified the presence of crevasse fillings some 4.8 km (3 mi) east of New Harbour. They exist in the form of two parallel ridges approximately 460 m (1509 ft) long and 520 m (1139 ft) wide and are described as straight, with undulating, uneven tops, and steep sides. The crevasse fillings are considered to have

been formed, after open cracks in the glacier were infilled with material from the surrounding ice which either slid or was washed into place. The ridges are composed of till and coarse glaciofluvial material, with angular boulders up to 1.5 m (4.9 ft) in diameter which are strewn over parts of the broad ridge tops.

3.1.5 Kame Terraces:

Clarkes Beach is the site of several large kame terraces. Along the north wall of the North River Valley, an irregular kame terrace extends approximately 3 km (1.9 mi) inland from the sea. In addition, a wide kame terrace extends along the south side of the South River Valley. Kame terrace deposits, mostly extensions of the South River deposit, continue around the nose of the 213 m (699 ft) hill that separates the North and South Rivers. These terrace deposits are typically composed of steeply dipping beds of well-sorted gravels.

3.1.6 Outwash Deposits:

Outwash plains and valley-train outwash deposits are present in the study area, but are small in number and occupy restricted areas mostly adjacent to the sea. Little information on the particle size distribution of the deposits is available. Vanderveer (1977) has identified probable

outwash gravel deposits near Swift Current and at the head of South West Arm, although he concludes that granular resources within the study area (both morainal and glaciofluvial) are limited.

3.2 Bedrock Geology

All of the study area is underlain by rocks of the Avalon tectonic-stratigraphic zone of the Newfoundland Appalachians (see Bedrock Geology - Map 1). Sedimentary and volcanic rocks of the Avalon Zone range in age from Late Precambrian to Late Cambrian or Early Ordovician. The rocks are scarcely metamorphosed and are relatively undeformed compared to rocks to the west, having been folded by open to locally tight northeast-trending anticlines and synclines. High-angle faults are common, and southeastwardly directed thrust faults are present on Bar Haven Island.

The map-units used in this report are grouped under the broad headings of "Eastern Avalon Zone" and "Western Avalon Zone". This has been done in deference to current nomenclature and to show the broad time-rock correlations between units. In geological terms, however, it is more correct to think of the volcanic and sedimentary rocks of the Avalon Zone as being divisible into four group assemblages

- three Precambrian and one Paleozoic. The basal Precambrian assemblage consists of subaerial volcanic rocks predominating over clastic sedimentary rocks (Harbour Main and Love Cove Gropus - Units 1 and 2 respectively). This is overlain by (and may be in part correlative to) an intermediate assemblage of marine siliceous slates and greywackes (Conception Group - Unit 3). The uppermost Precambrian assemblage consists of a thick sequence of shallow-water continental facies rocks in which arkosic sandstone and conglomerate are widespread (Hodgewater, Connecting Point and Musgravetown Groups - Units 4, 5 and 6 respectively). A basal volcanic unit is present in places (Bull Arm Formation - Unit 6A). The fourth assemblage is mostly Cambrian in age and is marked at its base everywhere by white quartzite of the Random Formation (Unit 8). This is overlain by a massive sedimentary sequence in which shale and slate predominate over siliceous limestone and minor sandstone and volcanic rocks (Adeyton and Harcourt Groups - Units 11 and 13 respectively , in the western Avalon Zone; and Bonavista, Smith Point and Brigus Formations - Unit 9, Chamberlains Brook and Manuels River Formations - Unit 10, and Elliott Cove Formation - Unit 12, in the eastern Avalon Zone).

The volcanic and sedimentary rocks of the Avalon Zone are intruded by three groups of plutonic rocks. Biotite

hornblended granite, syenite and granodiorite of Cambrian age or earlier (Unit 7) intrudes rocks of the Love Cove and Musgravetown Groups in the western part of the map area. Intermediate to basic plutonic rocks of probably Devonian age (Units 14 and 15) are widely present in the Placentia Bay area. The youngest rocks in the area are massive, coarse-grained granites of the Ackley Batholith; and less acidic, finer-grained intrusive rocks around Placentia Bay, all of which are Devonian in age.

The regional tectonic significance of the Avalon Zone is not yet fully understood. During Precambrian times the zone is thought to have been either a zone of rifting relating either to the opening of the Iapetus (Proto-Atlantic) Ocean to the west, or to a subduction event that preceeded the opening of the Iapetus Ocean. Correlatives of Avalon Zone rocks have been described on the other side of the present day Atlantic Ocean in western Europe and North Africa.

4 HYDROGEOLOGY

4.1 Introduction

The hydrogeologic characteristics, within any given region, will be largely influenced by the physical and chemical characteristics of the geologic materials. The porosity of these materials is one of the most fundamental physical characteristics. Porosity is classified as being either primary or secondary, the former pertains to the intergranular pore spaces within surficial or bedrock units, the latter deals with the voids produced by fractures or solution cavities within a rock mass. Movement of water within the surficial deposits of the Trinity Bay area is probably controlled by the primary permeability of the glaciofluvial and morainal deposits. Due principally to the age and in some cases the lithology, the bedrock units within the study area are probably largely dependent upon secondary permeability for ground water movement.

4.1.1 Data Availability:

Hydrogeological information originated from two main sources - the provincial Department of Environment (DOE) and Nolan, Davis & Associates. The hydrogeological assessment and characterization of the bedrock geologic units largely depended upon available drilled well records. The

Department of Environment, Water Resources Report 1-1 Groundwater Series (1979) was heavily relied upon in this assessment and characterization. A limited number of more recent (i.e. post 1979) logs were incorporated in this report. However, additional drilled well records were either unavailable from the local drillers or not forthcoming in time to be incorporated in this report.

Assessment and characterization of the surficial hydrogeological units, relied upon the surficial mapping conducted by the Geological Survey of Canada and the Newfoundland and Labrador - Department of Mines and Energy. Water Resources Report 1-1 (1979) provided very limited data on wells in surficial materials. Appendices A and B contain a listing, according to location, of all available drilled well records in the surficial and bedrock materials respectively.

The information usually available from the drilled well records includes location, well depth, casing length and generally, though not always, information on the well yield. Information on precise well location, overburden thickness, lithology and production/fracture zones was rarely, if at all, available from the drilled well records. The yield information available from the well records does not necessarily represent the short term and certainly does not

represent the long term safe yield of the well. Nevertheless, a "relative" comparison of the ground water potential in the bedrock units throughout the Trinity Bay area was possible.

Nolan, Davis & Associates has completed over 150 projects within the boundaries of the Trinity Bay study area - most of these projects involved either a direct or indirect hydrogeological component. From these projects, the results of 64 aquifer tests were used to better define and substantiate the estimated yield information from the drilled well records, both for surficial and bedrock wells. While water quality data provided information on ground water chemistry, other projects provided information on potential and existing problems within the study area. The comprehensive Shawinigan and MacLaren (1968) report, provided some very limited information pertinent to the study area.

4.1.2 Well Distribution:

Within the study area, the population centers are concentrated along the coast, thus most drilled wells are found around Trinity Bay and Conception Bay. The largest concentration of drilled wells exists along the western coast of Conception Bay. Consequently, drilled (and probably dug) wells have an irregular geographical and geological distribution within the Trinity Bay area.

The drilled wells were assigned to their respective geologic units based on the community in which the wells were drilled and the underlying geologic unit. While such an approach is not precise, it provided the only means of associating drilled wells with particular geologic units. Problems were encountered in the assignment of some drilled well records to appropriate geologic units. This was caused by the proximity of geologic contacts to particular populated communities or areas. Some of these areas included Bay Roberts, Clarkes Beach, Upper Island Cove, Adeyton, Islington, Normans Cove, St. Jones Within, Sunnyside, Cavendish and Roaches Line. Statistical comparison of the wells in question with other groups and examination of more detailed topographic maps, usually assisted in assignment of the wells to one particular geologic unit; for some wells classification was not possible. In these cases, the wells were either omitted from consideration or geologic units were combined (ex. 8/9 and 9/10) to provide a category for the wells.

Although there are 683 drilled bedrock wells within the Trinity Bay study area, only 662 could be classified geologically. Nearly all wells fall into either of two rock types - sedimentary and meta-sedimentary. The geologic distribution of the wells is as follows:

Rock Type	No. of Wells	% of Total
Sedimentary	464	70.1
Meta-sedimentary	189	28.5
Granitic	6	0.9
Volcanic (Bull Arm Formation)	3	0.5

A complete listing of the geologic units and the number and percent of wells within these units, is found in Table 4-1 for the Trinity Bay area.

Generally within the study area, there are very few drilled wells in surficial materials, in fact only 19 such wells have been obtained from the drilled well records. Because much of the information on the drilled well records is not completed by the drillers, including the overburden thickness, it is often difficult to identify which drilled wells are surficial wells. Typically, such wells have no screens but depend upon ground water entering either the bottom area of the casing, or a bottom zone one or two feet thick which is uncased (see Appendix A). In most cases, well drilling, screen selection, screen installation and well development, are done without proper supervision. Consequently, ground water producing zones are not properly identified, and screens are not properly sized and/or installed correctly within these zone(s). Very often these zone(s)

TABLE 4-1

GEOLOGICAL DISTRIBUTION OF WELLS

GEOLOGICAL UNIT	NAME	NO. OF WELLS	% OF TOTAL
1	Harbour Main Group	-	-
2	Love Cove Group	-	-
3	Conception Group	148	22.4
4	Hodgewater Group	419	63.3
5	Connecting Point Group	17	2.6
6	Musgravetown Group	45	6.8
6A	- Bull Arm Formation	3	0.5
7	Cambrian Granitic Rocks	6	0.9
8/9	Random/Bonavista, Smith Point and Brigus Formations	6	0.9
9/10	Bonavista, Smith Point and Brigus/Chamberlains Brook and Manuels River Formations	16	2.4
11	Adeyton Group	1	0.2
12	Elliot Cove Formation	-	-
13	Harcourt Group	1	0.2
14	Devonian Granitic Rocks	-	-
15	Devonian Igneous Rocks	-	-
	Total	662	

are not properly or fully developed. Most surficial drilled wells are completed in glaciofluvial, glaciolacustrine or glaciomarine deposits. The deposits at Clarkes Beach and Shoal Harbour contain most of the known drilled surficial wells. Come by Chance, North River, Georgetown and South River also have drilled surficial wells.

Although there is no information available on the number or distribution of dug wells in the surficial materials, it is likely that they would be located along the coast within or near the major population centers. This report makes no attempt to compile information on dug wells. It is known that dug wells are prevalent in the northern portion of the study area near Northwest Arm and Southwest Arm (J. Barry, Inspector - Department of Public Health, personnel communication).

4.1.3 Well Statistics:

As indicated, a total of 683 drilled bedrock wells have been compiled for the trinity Bay area, while 19 drilled surficial wells were available. These wells are located by community and numbered consecutively on the surficial and bedrock hydrogeologic maps (Maps 2 and 3 respectively). Just 399 bedrock drilled wells were utilized in the statistical analysis; only those wells having both yield and depth

information, were used in discussing the bedrock hydrostratigraphic units. Only 11 of the surficial wells had paired yield and depth information.

With one exception, no correlation exists between the values for well yield and depth within the various bedrock geologic units. A correlation coefficient (r) value of 0.72 was obtained for the paired data within the Cambrian granitic rocks. However, this is attributed to the small number of data points (6 wells) and not to the existence of any real correlation. No such correlations were found for the granitic rocks of the Bonavista Bay area to the north, although 347 wells within the granites were available for analysis.

4.2 Hydrostratigraphic Units

4.2.1 Introduction:

The concept of a hydrostratigraphic unit was developed to enable classification of geologic units for hydrogeologic purposes. Thus a hydrostratigraphic classification, refers to the water-bearing potential of a particular stratigraphically distinct geologic unit. This permits hydrogeologic grouping of geologically distinct units, based primarily on their ability to yield and/or transmit ground water. The

use of hydrostratigraphic units can be applied to both surficial and bedrock materials.

Due to the lack of data, the hydrostratigraphic units developed for the surficial materials were based on assessment of their potential yields, as opposed to actual estimated yields.

For several bedrock units little or no hydrogeologic information was available, as has been previously indicated; consequently, no hydrostratigrahic classification was attempted for those particular bedrock units. They have been referred to as N/C (Not Classified) on the accompanying map (Bedrock Hydrogeology - Map 3). However, based on the lithological nature of these units, there is no reason to believe that their yields would differ substantially from those groups and formations which were used in developing the hydrostratigraphic units.

4.2.2 Surficial Aquifers:

Only two surficial hydrostratigraphic units have been delineated within the Trinity Bay study area. This is principally due to:

a) the limited variety of surficial deposits

b) lack of information on these deposits

c) lack of information on wells (both dug and drilled) which have been constructed in surficial materials.

Many glaciofluvial, glaciolacustrine and glaciomarine deposits, within the Trinity Bay area, such as eskers, kames and deltaic sediments are small, and poorly defined and/or lacking in quantitative data. Consequently, the development of additional hydrostratigraphic units to accommodate them was considered neither justifiable nor meaningful. Deposits such as those mentioned above are briefly discussed within Surficial Hydrostratigraphic Unit - S2 and shall be considered as part of this unit until additional information suggests otherwise.

4.2.2.1 Surficial Hydrostratigraphic Unit - S1

This unit is comprised of the most prevalent and widespread surficial deposit occurring within the Trinity Bay study area - ground moraine. Undoubtedly, many domestic water supplies in the study area are derived from dug wells constructed in this unit. Most of these shallow domestic wells can probably be classified as poor producers, having average yields of less than 9 lpm (2gpm); the users typically depend heavily upon the storage capacity of the well.

The well-graded and dense nature of the tills which

comprise much of the ground moraine in the Trinity Bay area, accounts for their low to very low permeability. Based on field observations and sieve analyses, from various Nolan, Davis & Associates geotechnical projects, it is felt that permeabilities in the order of 10^{-5} to 10^{-8} cm/sec (3.3 x 10^{-7} to 3.3 x 10^{-11} ft/sec) can be expected within these tills.

The study area, like other areas of Newfoundland, has many problems associated with development of wells, for water supply purposes, in the local tills. Blasting is often required to increase the depth of the well when bedrock is encountered during construction. Due to insufficient soil cover, freezing of or frost damage to pumping equipment and water supply lines is a common winter problem. Water supplies from many dug wells are undependable during the summer months, when water table elevations drop below the penetration depth of the well. Where till thickness allows adequate penetration, few problems are encountered in reaching the water table with dug wells.

4.2.2.2 Surficial Hydrostratigraphic Unit - S2:

This hydrostratigraphic unit is presently comprised of all glaciofluvial, glaciolacustrine and glaciomarine deposits which lie within the Trinity Bay study area. Emphasis

is placed, however, on outwash sands and gravels and on kame terraces which, while not overly abundant, do offer the greatest potential for ground water development. The potential within Unit - S2 is far greater than that of the S1-Unit. The available data indicates that a number of drilled wells have been successfully constructed in either glacial outwash or kame terrace deposits. Information on the lithology and ground water potential of these deposits is quite limited since it has not been corroborated either through field work or laboratory testing.

Well records for the study area, compiled in Appendix A, indicate that at least 19 wells have been constructed in surficial deposits in the following communities: Clarkes Beach, Come by Chance, Georgetwon, North River, Shoal Harbour and South River. The wells supply water both for domestic and community/municipal use. Where the total depth of the wells has been recorded, these measurements range from 11.3 to 29.6 m (37 to 97 ft). In most cases the figure identifying the length of casing installed in the well corresponds to or exceeds the total depth of well. This indicates that well yield depends solely upon the open end of the casing, with none of the formation exposed through the use of a well screen. In very few instances is the well lithology described. In these few cases, the particular formation is described as one of the following - gravel, sand,

gravel with small boulders or, simply, overburden.

Static water level measurements are lacking with two exceptions, in both cases 3 to 9.2 m (10 to 30.2 ft) of saturated material is being utilized within the well. The drillers' estimates of well yield in Appendix A ranges from 9.1 - 159.1 lpm (2 - 35 gpm). Aquifer tests on two wells, one located in Clarkes Beach and the other in Shoal Harbour, indicated safe yields of 113 and 105 lpm (25 and 23 gpm) respectively. Both were cased to bottom, consequently, the yield in each well was derived from the 182 cm^2 (28 in^2) area at the bottom of the 150 mm (6 in) well.

As previously mentioned, a few small eskers have been identified inland within the study area. Typically, the eskers are composed of well sorted sands of relatively high permeability. Due to their configuration, the eskers are most often found to be well drained; subsequently they have a minimal saturated thickness.

4.2.3 Bedrock Aquifers:

4.2.3.1 Hydrostratigraphic Unit 1:

The ground water yielding potential of Hydrostratigraphic Unit 1, must be considered as poor relative to other bedrock hydrostratigraphic units within the Trinity

Bay study area. Wells drilled within this unit should be considered as only marginally useful in meeting modern domestic needs. However, older homes utilizing fewer water demanding conveniences or new homes that exercise more prudent water use, can probably obtain an adequate supply. Hydrostratigraphic Unit 1 has little potential for commercial or industrial applications. Well depths are slightly to significantly greater than more productive wells in other hydrostratigraphic units.

The meta-sedimentary rocks of the Connecting Point Group, the Random Formation and the Bonavista, Smith Point and Brigus Formations comprise this unit. A total of 23 wells have been drilled within these geologic units, although only 18 contain paired yield and depth information. Based on the available information, the mean yield is 10.0 lpm (2.2 gpm) with a standard deviation of 10.5 lpm (2.3 gpm) and a range of 1.1 - 38.6 lpm (0.25 - 8.5 gpm). The mean well depth is approximately 54.7 m (179.4 ft) with a standard devaition of 22.3 m (73.2 ft) and a range of 11.3 - 103.6 m (37 - 340 ft). None of the wells within this unit have yields in excess of 45 lpm (10 gpm) while 50% have yields between 0 - 4.5 lpm (0 - 1 gpm). Table 4-2 summarizes the data for this hydrostratigraphic unit.

While the existing data suggests that poor ground

TABLE 4-2

BEDROCK WELL STATISTICS

HYDROSTRATIGRAPHIC UNIT	GEOLOGICAL UNIT	NO. OF WELLS	YIELD (lpm)				DEPTH (m)			
			MEAN VALUE	RANGE	NO. & % OF WELLS YIELDING 0 - 4.5	NO. & % OF WELLS YIELDING >45	MEAN VALUE	RANGE	NO. & % OF WELLS BOTTOMING 0 - 30	NO. & % OF WELLS BOTTOMING >61
1	5, 8 & 9	18	10.0	1.1-38.6	9/50%	0/0 %	54.7	11.3-103.6	2/11.1%	8/44.4%
	5	13	10.5	1.1-38.6	6/46.2%	0/0 %	50.4	11.3-85.3	2/15.4%	5/38.5%
	8/9	5	9.5	<2.3-25.5	3/60 %	0/0 %	65.8	51.8-103.6	0/0%	3/60 %
2	3 & 6	114	23.2	2.3-295.5	27/23.7%	10/8.8%	54.0	13.7-143.3	28/24.6%	39/34.2%
	3	76	23.2	2.3-159.1	14/18%	8/10.5%	57.1	17.4-143.3	14/18.4%	30/39.5%
	6	38	22.3	1.1-295.5	13/34.2 %	2/5.3 %	47.9	13.7-93.6	12/31.6%	9/23.7%
3	7, 9 & 10	12	29.5	13.6-68.2	0/0 %	4/33.3%	53.5	18.3-80.8	2/16.7%	7/58.3%
	7	3	27.3	13.6-54.6	0/0 %	1/33.3%	53.7	33.5-80.8	0/0%	3/100 %
	9/10	9	30.0	18.2-68.2	0/0 %	3/33.3%	53.4	18.3-79.2	2/22.2%	4/44.4%
4	4	250	33.2	2.3-454.6	19/7.6%	38/15.2%	44.8	11.3-115.8	87/34.8%	46/18.4%
N/C	4/8/9	4	16.4	9.1-27.3	0/0 %	0/0 %	46.5	21.6-79.2	1/25 %	1/25 %
N/C	11	1	227.3	-	0/0 %	1/100 %	61	-	0/0%	0/0%
	TOTAL	399								

N/C - not classified (see Section 4.1.3)

water yields can be expected in this hydrostratigraphic unit, considerably more data will be required to realistically substantiate this conclusion. The present inability to separate the influence of the Random Formation versus the Bonavista, Smith Point and Brigus Formations, further complicates the attempt to classify these geologic units in terms of their hydrostratigraphic potential.

Hydrostratigraphic Unit 1 is prevalent throughout the central portions of the study area, including Random Island, Southwest Arm, the Isthmus of Avalon and Long Island (see Map 3).

4.2.3.2 Hydrostratigraphic Unit 2:

In relative terms, Hydrostratigraphic Unit 2 has good ground water yielding potential. It is capable of providing ground water yield sufficient to meet domestic needs and to offer some potential for supplying low demanding industrial, commercial or municipal applications. Substantially higher yields meeting non-domestic demands might be obtainable. In this unit, well depths will be significantly greater than most bedrock drilled wells within the study area.

The Conception Group-meta-sedimentary and the Musgravetown Group-sedimentary and volcanic rocks, are

contained in this hydrostratigraphic unit. Although 198 wells were drilled within the geologic units that comprise Hydrostratigraphic Unit 2, only 114 wells were selected for analysis. The mean yield for this unit is 23.2 lpm (5.1 gpm) with a standard deviation of 37.3 lpm (8.2 gpm) and a range of 2.3 - 295.5 lpm (0.25 - 65 gpm). The mean well depth is 54.0 m (177.3 ft) with a standard deviation of 26.9 m (88.3 ft) and a range of 13.7 - 143.3 m (45 - 470 ft). Approximately 24% of the wells in Hydrostratigraphic Unit 2 have yields between 0 - 4.5 lpm (0 - 1 gpm) while 8.8% have yields >45 lpm (>10 gpm). Almost 25% of the wells within this unit have depths of 0 - 30 m (0 - 100 ft) while 34.2% of the wells had depths >61 m (>200 ft).

Compared to the Bonavista Bay area, the well yields for the Musgravetown Group in the Trinity Bay area are reduced (28.6 lpm versus 22.3 lpm); the mean well depths were greater for the Trinity Bay area (44.7 m versus 47.9 m). Within the Conception and Musgravetown Group, the mean yields were 23.2 lpm (5.1 gpm) and 22.3 lpm (4.9 gpm) respectively, with standard deviations of 30.9 lpm (6.8 gpm) and 48.2 lpm (10.6 gpm) respectively. The mean well depths within these two Groups were 57.1 m (187.4 ft) and 47.9 m (157.1 ft) respectively, with standard deviations of 28.2 m (92.5 ft) and 23.3 m (76.5 ft) respectively.

Hydrostratigraphic Unit 2 is a very extensive unit, it is found in the northwest and southwest portion of the study area, along the Isthmus of Avalon and the west coasts of Trinity Bay and Conception Bay (see Map 3).

4.2.3.3 Hydrostratigraphic Unit 3:

In terms of the potential for meeting domestic requirements, Hydrostratigraphic Unit 3 should be considered as good to excellent. However this assessment is based on very limited data. Although this unit was classified on the basis of 12 wells (from a total of 22), it offers excellent potential for meeting all domestic requirements and limited potential for restricted industrial, commercial and municipal applications. Mean well depths within this unit, although slightly less than Hydrostratigraphic Units 1 and 2, are considerably deeper than most wells drilled within the study area.

Hydrostratigraphic Unit 3 consists of Cambrian or earlier granitic rocks, the Bonavista, Smith Point and Brigus Formations, and/or the Chamberlains Brook and Manuels River Formations. The data indicates a mean yield of 29.5 lpm (6.5 gpm) with a standard deviation of 20.9 lpm (4.6 gpm) and a range of 13.6 - 68.2 lpm (3 - 15 gpm). The mean well depth is 53.5 m (175.4 ft) with a standard deviation of 22.2 m (73 ft) and a range of 18.3 - 80.8 m (60 - 265 ft).

Surprisingly, no wells in this unit have yields between 0 - 4.5 lpm (0 - 1 gpm) while 33.3% of the yields are >45 lpm (>10 gpm). However, 58.3% of the wells are deeper than 61 m (200 ft) while only 16.7% have depths from 0 - 30 m (0 - 100 ft).

It is interesting to note that the granitic units, within the Trinity Bay and the Bonavista Bay study areas, generally have good ground water potential. Hydrostratigraphic Unit 5, the most productive unit in the Bonavista Bay study area, consists entirely of granitic rock (Newfoundland and Labrador, Department of Environment, Water Resources Report 2-3, in press). The mean well yields and depths for the granitic rocks in the Bonavista and Trinity Bay areas are very similar. For Bonavista Bay study area, the mean well yield and depth was 26.4 lpm (5.8 gpm) and 56.1 m (184.1 ft) respectively, versus 27.3 lpm (6 gpm) and 53.7 m (176.3 ft) respectively, for the Trinity Bay study area.

Much of this hydrostratigraphic unit lies northwest of the head of Placentia Bay, within sparsely populated portions of the study area. It is also found in the vicinity of Chapel Arm and Hearts Delight within Trinity Bay.

4.2.3.4 Hydrostratigraphic Unit 4:

Compared to other units within the Trinity Bay area, Hydrostratigraphic Unit 4 offers good to excellent ground water potential. It is the most productive and widely utilized hydrostratigraphic unit within the study area. Its ability to meet any domestic need should be considered excellent, based on the substantial number of recorded drilled wells within this unit. It also offers reasonable potential for supplying low demanding industrial, commercial and municipal applications. In some cases, substantially greater demands could be met by Hydrostratigraphic Unit 4 for high demanding users of ground water. This unit has produced several wells that have estimated yields in the vicinity of 455 lpm (100 gpm). However, utilization of proper siting and well drilling techniques; to take advantage of local topography, potential infiltration systems, fracture lineations and encountered production zones; will be required, if, such yields are to be obtained by methods other than chance. It is very likely that the prominant northeast-southwest lineations, have had some enhancing influence on this unit's ability to yield ground water.

Hydrostratigraphic Unit 4 consists entirely of rocks from the sedimentary Hodgewater Group. While a total of 419 wells have been drilled within this unit, only 250 had corresponding yield and depth information. Such a large

number considerably improves the reliability of the statistical parameters calculated. The mean yield is 33.2 lpm (7.3 gpm) with a standard deviation of 47.3 lpm (10.4 gpm) and a range of 2.3 - 454.6 lpm (0.5 - 100 gpm). The mean well depth is 44.8 m (147 ft) with a standard deviation of 21.8 m (71.5 ft) and a range of 11.3 - 115.8 m (37 - 380 ft). Approximately 15% of the wells have yields in excess of 45 lpm (10 gpm) while 7.6% report yields of 0 - 4.5 lpm (0 - 1 gpm). Typically, within the Trinity Bay study area, wells drilled within Hydrostratigraphic Unit 4 can expect larger yields at shallower depths. In fact, wells drilled within this unit have significantly lower mean well depths when compared to the other units.

This unit is found exclusively in the eastern portion of the Trinity Bay study area, between Trinity Bay and Conception Bay, and in the area southeast of Trinity Bay (see Map 3).

4.3 Ground Water Flow Systems

The water table surface will model the overlying and surrounding topography but will reflect it more subtly (Toth, 1963). Ground water flow will be in response to the differences in total potentiometric head between any two points which in turn, will be governed by changes in the

elevation head and pressure head. The concepts of ground water flow within small basins (maximum 1000 km^2/368 mi^2 in area), as characterized by Toth (1963), are particularly well suited for studying the ground water flow regimes within the Trinity Bay study area. Many of the flow basins in the study area are probably small, due to the proximity of the coast.

Throughout most of the study area it is likely that either local or intermediate flow systems will predominate. As defined by Toth (1963), "A local system of ground water flow has its recharge area at a topographic high and its discharge area at a topographic low that are located adjacent to each other". Intermediate flow systems will develop where the ground water recharge and discharge areas, are not necessarily located at either the highest or lowest topographic elevations. While larger scale intermediate flow systems may be present within the study area, its influence on ground water flow within the population centers is probably small. Consequently, the physical and chemical characteristics of the ground water utilized in most coastal and many inland areas will probably be controlled by local flow systems. Thus, even within the same geologic unit, variations in ground water characteristics are likely to occur throughout the study area.

Due to the rapid change in topographic relief,

especially along the coast and the proximity of the coast in most of the Trinity Bay study area, local flow systems will predominate. In the northwestern and western parts of the study area where the influence of the coast is less pervasive, intermediate or even regional flow systems may develop.

These flow systems will be influenced and in some areas controlled, by the prominent and well defined northeast-southwest (NE-SW) structural trends found throughout the Trinity Bay area. These structural features are represented by NE-SW trending faults and synclinial-anticlinial structures which are often tightly folded. In the central portion of the study area, a north-northwest to south-southeast (NNW-SSE) trend is defined by faults. Indeed, there are few regions in the study area where defined or undefined structural features do not exist. The western portion of Conception Bay, within Hydrostratigraphic Unit 4, has numerous NE-SW topographic lineaments which in many cases could represent either defined or undefined faults. As previously mentioned, this may be one explanation for the larger yields reported within this densely populated portion of the hydrostratigraphic unit.

As a consequence of these structural trends, substantial ground water flow components can probably be expected in NE-SW and, to a lesser extent, in NNE-SSW directions,

throughout the bedrock hydrostratigraphic units of the Trinity Bay area. It is likely that there is rapid movement of ground water through these fracture systems to the coast from topographically higher recharge areas further inland; Hydrostratigraphic Units 2 and 4 are most likely to exhibit this characteristic.

Most bedrock and surficial aquifers within the study area can be considered as unconfined and although truely confined aquifers certainly do exist, they are probably the exception rather than the rule. This is based on the experience of Nolan, Davis & Associates in the study area, the drilled well records and the predominance of fracture flow. Consequently, the water table surface, rather than the potentiometric surface, will define the upper boundary of the saturated zone from which available ground water can be obtained. The water table surface will fluctuate seasonally. Generally it rises in the spring and fall in reponse to recharge events such as snow melt and/or precipitation. During the winter and summer it drops due to:

a) lack of recharge
b) continued natural discharge of ground water into surface water bodies
c) evapotranspiration.

Seasonal fluctuations within the study area may

vary widely. They will generally, though not necessarily, be greater within bedrock aquifers than surficial aquifers (thus normally productive dug wells may become dry in the summer). Variation in seasonal fluctuations can be expected throughout the study area in response to local conditions. Changes of 0.5 to 1.5 m (1.6 to 4.9 ft) and 1.5 to 3 m (4.9 to 9.8 ft) for surficial and bedrock aquifers, could be considered representative, based on experience within the Trinity Bay study area (J. Robinson - Department of Environment, F. Nolan and B. Davis - Nolan, Davis & Associates, personal communication).

4.4 Aquifer Tests

A substantial number of aquifer or pump tests have been conducted for the Trinity Bay study area and for several reasons these tests warrant further discussion.

Aquifer tests involve pumping a well at a constant rate, for a specific period of time, to test a certain saturated thickness of aquifer. Using various formulae, one can determine the amount of drawdown a well, or surrounding wells, will experience after any period of time, given a relatively constant pumping rate. Typically, short-term aquifer tests of 72 hours duration are conducted to establish the realiability of a ground water supply. Where justified,

such aquifer tests may be conducted for a period of weeks or months - not just hours. In cases where the yield is not known or not well-defined, a step-drawdown test must preceed any aquifer testing.

A total of 62 bedrock aquifer tests have been conducted in the last 12 - 14 years within the study area; Figure 4-1 locates the communities where these tests have been performed. With two exceptions, these tests are equal to or less than 24 hours in duration, the mean duration is 17.5 hours with a standard deviation of 9.5 hours and a range of 2 - 70 hours. Generally, the recovery periods are 1.5 hours in duration. The pumping rates in 58% of the tests, ranged between 0.9 and 22.7 lpm (0.2 - 5 gpm) while in 21% of the tests, the range was 22.7 - 45.5 lpm (5 - 10 gpm). Table 4-3 lists all the aquifer tests completed in the Trinity Bay area according to community and geological unit.

Over 80% of the aquifer tests have been conducted on wells within the Hydrostratigraphic Unit 4, i.e. the Hodgewater Group. The mean safe yield is 49.6 lpm (10.9 gpm) with a standard deviation of 88.6 lpm (19.5 gpm). This mean value compares, very approximately, to the 33.2 lpm (7.3 gpm) mean value obtained from the drilled well records (see Table 4-2). Although the aquifer test results are 49% greater than the well records, such a difference is not

BONAVISTA BAY
Department of Environment
Government of Newfoundland and Labrador
25 0 25
KILOMETRES
SHOAL HARBOUR
GRATES COVE
BAY de VERDE
TRINITY BAY
HANT'S HARBOUR
NEW CHELSEA
LOWER ISLAND COVE
SWIFT CURRENT
WESTERN BAY
BROAD COVE
COME BY CHANCE
SALMON COVE
VICTORIA
FRESHWATER
CAVENDISH
HARBOUR GRACE
BRYANTS COVE
UPPER ISLAND COVE
GREEN'S HARBOUR
TILTON
BISHOP'S COVE
LITTLE HARBOUR
NEW HARBOUR
BAY ROBERTS
DILDO
DILDO SOUTH
CON BAY
PLACENTIA BAY
HYDROGEOLOGY OF TRINITY BAY AREA
Figure 4-1
Aquifer test locations
NOLAN, DAVIS & ASSOCIATES LIMITED

TABLE 4-3

AQUIFER TEST DATA

LOCATION	PUMPING RATE (lpm)	RANGE IN PUMPING RATE (lpm)	TEST DURATION (HOURS)		ESTIMATED SAFE YIELD (lpm)
			PUMPING	RECOVERY	
		HODGEWATER GROUP			
Bay de Verde			19.5	1.5	3.4
Broad Cove	15.9		20	1.5	5.5
Bryants Cove	32/36		22	3	27.3
Bryants Cove	19.1		18	3	18.2
Dildo	114/136		32.7	2.5	182
Dildo	55/59	23-227	24	1.5	77
Dildo South	32		9.8	1.5	30
Dildo South	33		6	1.5	32
Dildo South	18	18-30	19	1.5	18
Dildo South	11	9-18	20	1.5	7
Freshwater	23	23-45	22	1.5	16
Freshwater	9	8-14	20	4	7
Grates Cove	91		20	1.5	64
Grates Cove	64/91	45-114	20	-	50
Greens Harbour	32/39	28-48	7	1.5	41
Greens Harbour	14/18	9-27	16	2	16
Greens Harbour	5/9	5-9	6.7	1.5	6
Greens Harbour	20	18-21	6	2	18
Greens Harbour	39/45	34-59	6	1.5	55
Hants Harbour	27		7	3	30
Harbour Grace	6		8.5	1.5	5
Harbour Grace	23		24	3	30
Lower Island Cove	20/23	19-27	8.5	1.5	20
Lower Island Cove	8/14	8-16	11.5	2.5	8
Lower Island Cove	114	91-170	21	1.5	91
New Chelsea	91/118		2	1.5	55
New Harbour	2		7.5	-	2
New Harbour	9		8	3	7
New Harbour	-		-	-	36
Salmon Cove	191		8	0.5	>455

TABLE 4-3
(cont'd)

LOCATION	PUMPING RATE (lpm)	RANGE IN PUMPING RATE (lpm)	TEST DURATION (HOURS)		ESTIMATED SAFE YIELD (lpm)
			PUMPING	RECOVERY	
Salmon Cove	18/23	16-45	8.8	-	18
Salmon Cove	14	9-34	19	0.7	18
Salmon Cove	39		17.5	2	36
Salmon Cove	18	7-18	20	1.5	3
Salmon Cove	114		16	1.5	32
Salmon Cove	55	36-114	22	1.5	5
Salmon Cove	32/41	27-114	24	1.25	32
Salmon Cove	32/114	27-114	20	1.75	23
Salmon Cove	27/55		23	1.5	45
Salmon Cove	205		24	1	>227
Salmon Cove	27/55	11-23	23	0.5	27
Salmon Cove	23		12	0.5	27
Salmon Cove	23		13	0.3	23
Tilton	23	11-27	19.6	1.5	18
Tilton	11/14	11-18	13	1.5	14
Victoria	36	28-44	22.5	1	36
Western Bay	7	3-34	7.75	1.5	5
Western Bay	68	68-170	21	1.5	68
Western Bay	114		20	1	409
Whiteway	14/16		21		11
		CONCEPTION GROUP			
Bay Roberts	5	1-10	22	1.5	2
Bishops Cove	5	5-10	24	1.5	5
Upper Island Cove	36		17	1	57
Upper Island Cove	7		11.25	1.75	5
Upper Island Cove	36	34-41	24	1	91
		CONNECTING POINT GROUP			
Come by Chance	23		17	1	22
Little Harbour	39		21	2	36
Little Harbour	2/7	1-36	22	6	<2
Little Harbour	8	5-34	22	3	7
		MUSGRAVETOWN GROUP			
Shoal Harbour	123		70	1.5	295

TABLE 4-3
(cont'd)

LOCATION	PUMPING RATE (lpm)	RANGE IN PUMPING RATE (lpm)	TEST DURATION (HOURS)		ESTIMATED SAFE YIELD (lpm)
			PUMPING	RECOVERY	
		PRECAMBRIAN GRANITE			
Swift Current	15	11-170	21	3	14
		GEOLOGIC UNITS 4/8/9			
Cavendish	9/11	9-11	8.7	2	11

unreasonable.

Six (i.e. 10%) of the aquifer tests were conducted within Hydrostratigraphic Unit 2; the anomolous safe yield of 295.5 lpm (65 gpm), obtained from the Shoal Harbour test within the Musgravetown Group, is not considered in the following statistics since it is not representative of this unit. The mean safe yield is 31.8 lpm (7 gpm) with a standard deviation of 40.5 lpm (8.9 gpm); it compares approximately with the 23.2 lpm (5.1 gpm) mean value obtained from the drilled well records (see Table 4-2).

Within the Connecting Point Group component of Hydrostratigraphic Unit 1, 4 (i.e. 6%) of the aquifer tests have been conducted. The mean safe yield is 16.8 lpm (3.7 gpm) with a standard deviation of 15.5 lpm (3.4 gpm). The mean safe yield obtained from the aquifer tests compares, very approximately, with the mean value of 10.5 lpm (2.3 gpm) calculated from the drilled well records.

The 49, 37 and 60% increases in mean aquifer test values, for the Hodgewater, Musgravetown and Connecting Groups respectively, over the mean drilled well record values, while substantial, are not unexpected. The differences could be largely explained by:

a) the aforementioned inaccuracy of the blow/air lift or bail tests conducted by the driller

b) the existence of a bias in conducting aquifer tests i.e. productive wells, rather than low yielding wells will be tested more frequently

c) the failure to achieve a steady-state condition during the very short test period.

Problems associated with the aquifer tests conducted in the Trinity Bay area include their short duration and the variation in pumping rate. As previously indicated, test interpretation depends upon the assumption of a constant pumping rate, this is obviously not the case for most of these aquifer tests. Often tests are conducted on wells for which little or no accurate yield information exists. Consequently, invaluable time is lost during these already short aquifer tests. Trying to establish an optimum pumping rate, in very short test periods; a constant pumping rate may never be achieved (B. Davis - Nolan, Davis & Associates, personal communication). Very rarely can a driller's estimate of yield be used as an optimum constant pumping rate for an aquifer test. None of the aquifer tests listed in Table 4-3 have been preceded by any form of step-drawdown testing.

It is critically important in any aquifer testing

that the cone of depression extends far enough away from the well to initiate steady-state flow conditions. This will enable one to define flow boundary conditions that exist in the immediate vicinity of the well. According to Kruseman and deRidder (1976), "Since in a water table aquifer the cone of depression expands slowly, a longer period of pumping is required and it is common practice to pump the well for three days". As indicated in Section 4.4, unconfined or water table aquifers predominate throughout the Trinity Bay area. Based on a cursory examination of the aquifer test results for the study area, steady-state or near steady-state conditions were not approached during most test periods.

In the Trinity Bay area, the problems associated with aquifer tests - short duration and variable pumping rate, are a consequence of economic factors. In most cases the non-domestic user of ground water is very reluctant to spend the money required to properly assess an aquifer or well (B. Davis - Nolan, Davis & Associates, personal communication). It is important to appreciate that in many cases the testing costs involved are a very small percentage (<2%) of the total development costs (i.e. for a plant, school or surface water supply). Nevertheless, the potential user often does not appreciate the necessity for proper aquifer testing. The recent enactment of the Well Drilling Act by the provincial

legislature, now requires that all non-single family wells be properly tested for a period of 6 - 72 hours (J. Robinson - Department of Environment, personal communication).

5 HYDROLOGY

5.1 Introduction

As a further aid in characterizing the hydrogeological resources of the Trinity Bay area, available hydrological data was assessed to determine:

a) the rate of annual ground water recharge

b) the availability of the ground water resource for pumping from surface water intake structures.

Streamflow within the study area is monitored by Environment Canada - Water Survey of Canada at three sites (see Figure 5-1). Table 5-1 lists the relevant information. Due to the long period and quality of record Pipers Hole River data was given priority, augmented with the Come by Chance River data.

The Pipers Hole and Come by Chance River basins are

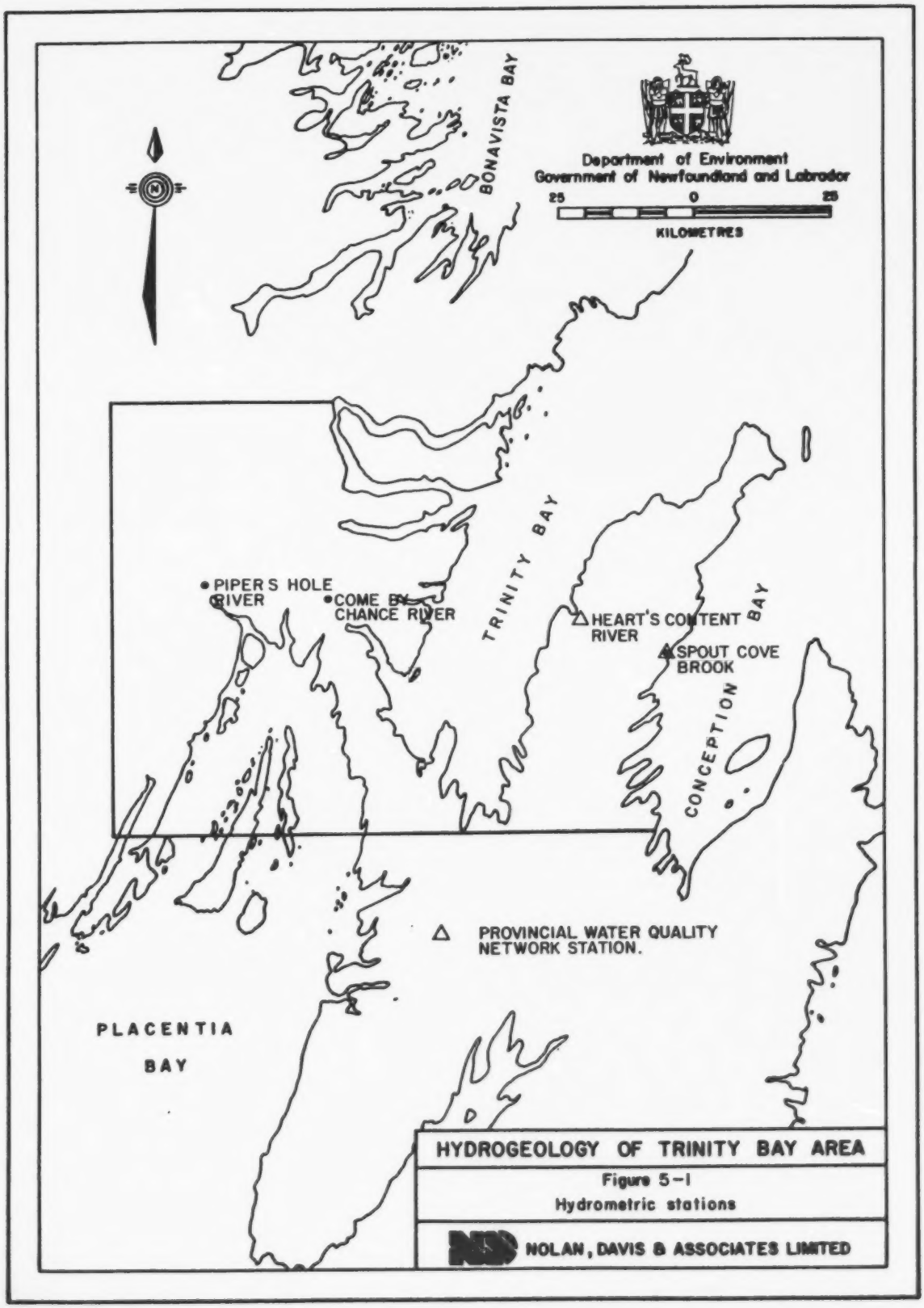

BONAVISTA BAY
Department of Environment
Government of Newfoundland and Labrador
25 0 25
KILOMETRES
TRINITY BAY
PIPER'S HOLE RIVER
COME BY CHANCE RIVER
HEART'S CONTENT RIVER
SPOUT COVE BROOK
CONCEPTION BAY
PROVINCIAL WATER QUALITY NETWORK STATION.
PLACENTIA BAY
HYDROGEOLOGY OF TRINITY BAY AREA
Figure 5-1
Hydrometric stations
NOLAN, DAVIS & ASSOCIATES LIMITED

TABLE 5-1

HYDROMETRIC STATION DATA

STATION NAME AND NUMBER	LOCATION	DRAINAGE AREA	TYPE OF FLOW	PERIOD OF RECORD
Pipers Hole River near Mothers Brook #02ZH001	Lat 47 56 49N Long 54 17 08W	764 km^2	natural flow	Nov. 1952 to present
Come by Chance River near Goobies #02ZH002	Lat 47 55 07N Long 53 56 59W	37.5 km^2	natural flow	Jan. 1961 to Dec. 1961 Nov. 1969 to present
Spout Cove Brook near Spout Cove #02ZL003	Lat 47 48 43N Long 53 09 15W	10.8 km^2	natural flow	Jan. 1979 to present

generally underlain by similar bedrock and surficial geology. The surficial geology consists of thin, discontinuous sandy till. The bedrock geology comprises an approximately equal percentage of sedimentary and igneous rock types. The former are physical (i.e. non-chemical) rock types of terrestrial origin encompassed by the Musgravetown Group (Hydrostratigraphic Unit 2). The latter comprise acid to basic igneous rock types encompassed by the Sound Island Formation and Devonian and earlier igneous intrusives (neither of these two units are classified hydrostratigraphically).

The similarity in bedrock lithology over both basins, provides two good sources of data to characterize both ground water recharge and availability on a regional scale for the tectono-stratigraphic Avalon zone. However, it limits the predictability of ground water recharge and availability, for other regions within the study area, as well as individual hydrostratigraphic units within each region.

5.2 Ground Water Recharge

The annual recharge to the regional ground water flow system may be estimated from the annual discharge of ground water to surface streams assuming no change in storage.

Assessment of the hydrographs for the three station revealed an anomoly of periodic seasonal trend reversal whereby low flows were encountered in mid winter, rising to high runoff in summer. The trend is valid and natural, having been described by Shawinigan and MacLaren (1968) as the "Labrador" pattern. The Pipers Hole River showed the "normal" pattern except for one season in which the difference was sufficiently small to be ignored. The records of the Come by Chance River and Spout Cove Brook produced definite "Labrador" patterns. Consequently, more emphasis was placed on use of the Pipers Hole River data.

To quantify annual rates of ground water discharge, the stream flow data was computerized and the ground water flow separation carried out, by joining the low points, on the minimum monthly flow hydrographs, for each water year within the entire period of record. The water year was taken from the lowest flow in one year, to the lowest flow in the following year, in an attempt to minimize changes in storage. The minimum monthly hydrograph was used to create a conservative estimate. Based on previous work in the Bonavista Bay area, its reliability compared quite favourably with the results of the mean daily hydrograph. Table 5-2 summarizes the results of the base flow separation completed for the period of record and shows the water year of maximum, minimum and mean ground water discharge. It indicates that the annual volume of

TABLE 5-2

HYDROLOGIC SUMMARY OF WATER YEARS

Parameters measured/calculated	Pipers Hole River near Mother's Brook (period of record 1954-1978)			Come by Chance River near Goobies (period of record 1976-1979)		
	mm on Drainage Area			mm on Drainage Area		
	maximum	minimum	mean	maximum	minimum	mean
Year	1958-9	1960-1	1970-1*	1977-8	1978-9	1976-7*
Total stream discharge/year (ground and surface water)	1021	741	1562	1579	1081	1211
Total estimated ground water discharge/year	288	59	178	134	68	106
Ratio: ground water/stream discharge	0.28	0.08	0.11	0.09	0.06	0.09

* year nearest to mean

ground water discharged into the Pipers Hole River, has a mean value of 178 mm over the drainage basin and ranges from 59 - 288 mm. This volume forms 8 - 28% (mean 11%) of the total annual volume of water discharged through the river at the gauging station. The stream discharge is greater for the mean year than the maximum year, indicating a larger surface water flow. The annual volume of ground water discharged into the Come by Chance River, has a mean value of 106 mm over the drainage basin and ranges from 68 - 134 mm. This volume forms 6 - 9% (mean 9%) of the total annual volume of water discharged through the river at the gauging station.

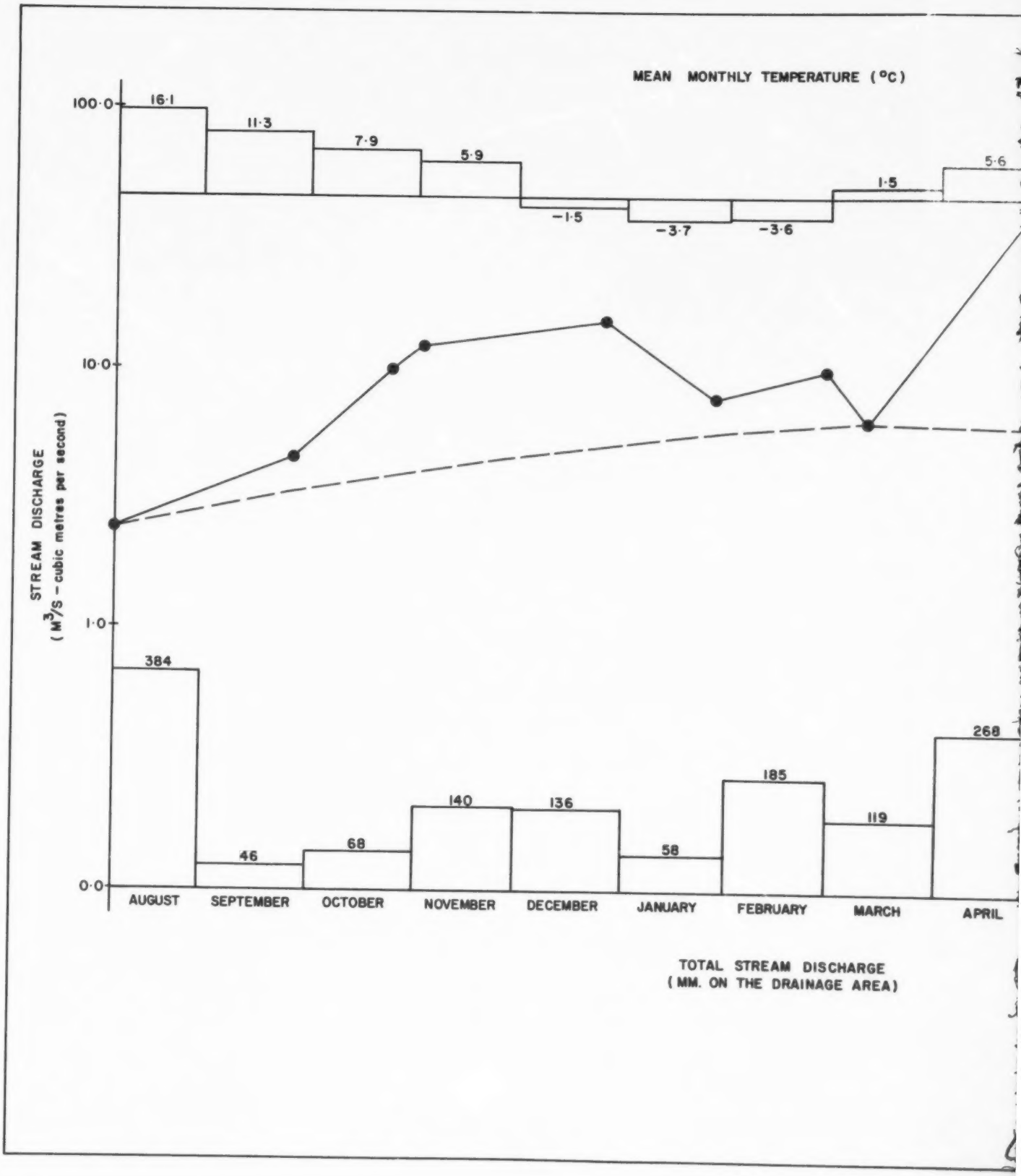
The hydrographs of the mean years (i.e. the year with the mean annual ground water discharge over the period of record) are shown in Figures 5-2 and 5-3 respectively.

Unfortunately precipitation data could not be included in Table 5-2 or Figures 5-2 and 5-3 for reasons previously discussed (Section 1.4.1). Although the study area contains eight climatological stations, the stations are predominantly located on the shores of Trinity Bay. Therefore they give little direct indication of the precipitation received within the gauged areas of either river, which lie at higher inland elevations.

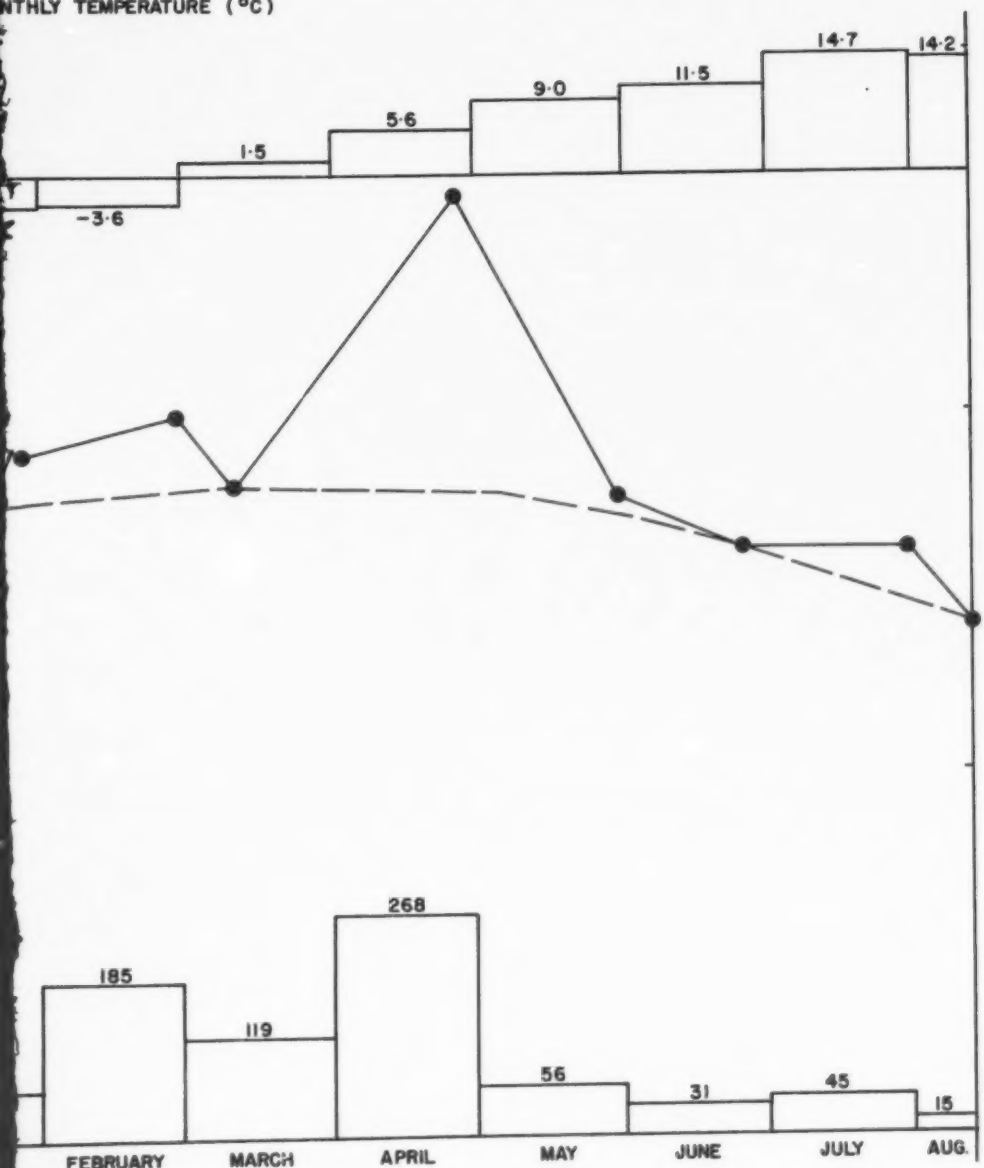
To check the validity of utilizing the precipitation data water balance calculations were made for both rivers. The precipitation data was derived from the sporadic records of the existing stations after checks were made for homogeneity and correlation with the Gander Airport station utilizing a double mass curve technique. Evapotranspiration was calculated by the Thornthwaite (1948) and Turc (Gray, 1970) methods. Using the annual means of evapotranspiration, precipitation and runoff, the water balance equation resulted in water losses of 7, 426 and 430 mm (0.28, 16.8 and 16.9 in) over the drainage basins of Pipers Hole River, Come by Chance River and Spout Cove Brook respectively. It was therefore felt that the existing precipitation data was not representative of that received with the gauged areas. It is believed that the problems in obtaining a satisfactory water balance stem from the following:

a) the small number and short period of record for climatic stations within the study area, in combination with, the absence of any stations on the higher elevations associated with the middle headwaters of the basins

b) the theoretical determination of evapotranspiration in a humid marine climate and the extrapolation of such data (as well as evaporation pan data), from the existing climatic stations, to the higher elevations in the headwaters of the watersheds


MEAN MONTHLY TEMPERATURE (°C)
100·0
10·0
1·0
0·0
16·1
11·3
7·9
5·9
-1·5
-3·7
-3·6
1·5
5·6
STREAM DISCHARGE
(M³/S - cubic metres per second)
384
46
68
140
136
58
185
119
268
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
TOTAL STREAM DISCHARGE
(MM. ON THE DRAINAGE AREA)

NTHLY TEMPERATURE (°C)



AL STREAM DISCHARGE
ON THE DRAINAGE AREA)

Department of Environment
Government of Newfoundland and Labrador

NOTES: a) Hydrograph based on minimum monthly discharge values.

b) Temperature data from the Long Harbour station.

c) Annual mean monthly temperature 7·0° C.

d) Total stream discharge in mm. on the drainage basin is 1562 mm.

HYDROGEOLOGY OF TRINITY BAY AREA

Figure 5-2
Ground water hydrograph — Pipers Hole River
(For mean flow year, 1970-1971)

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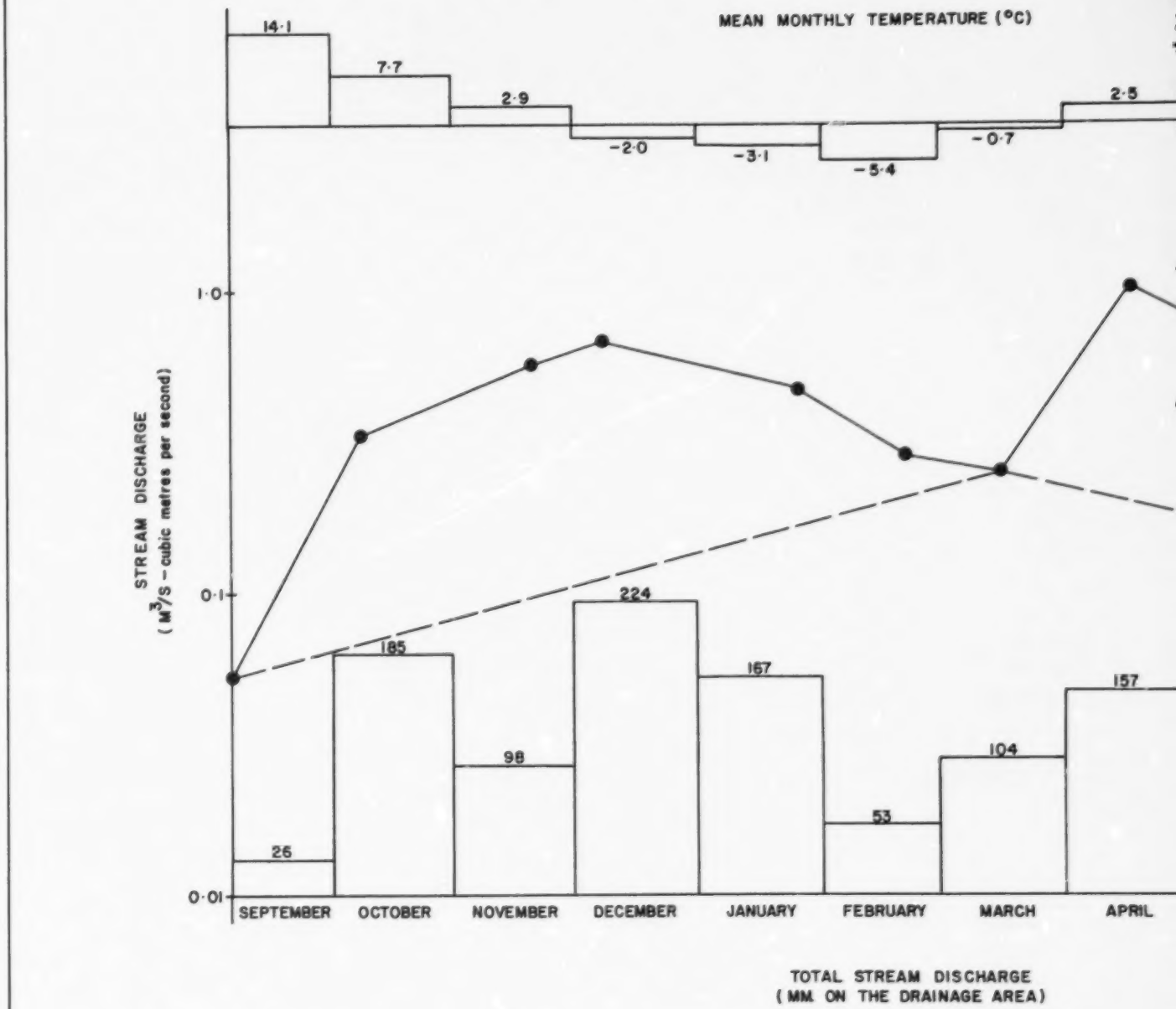
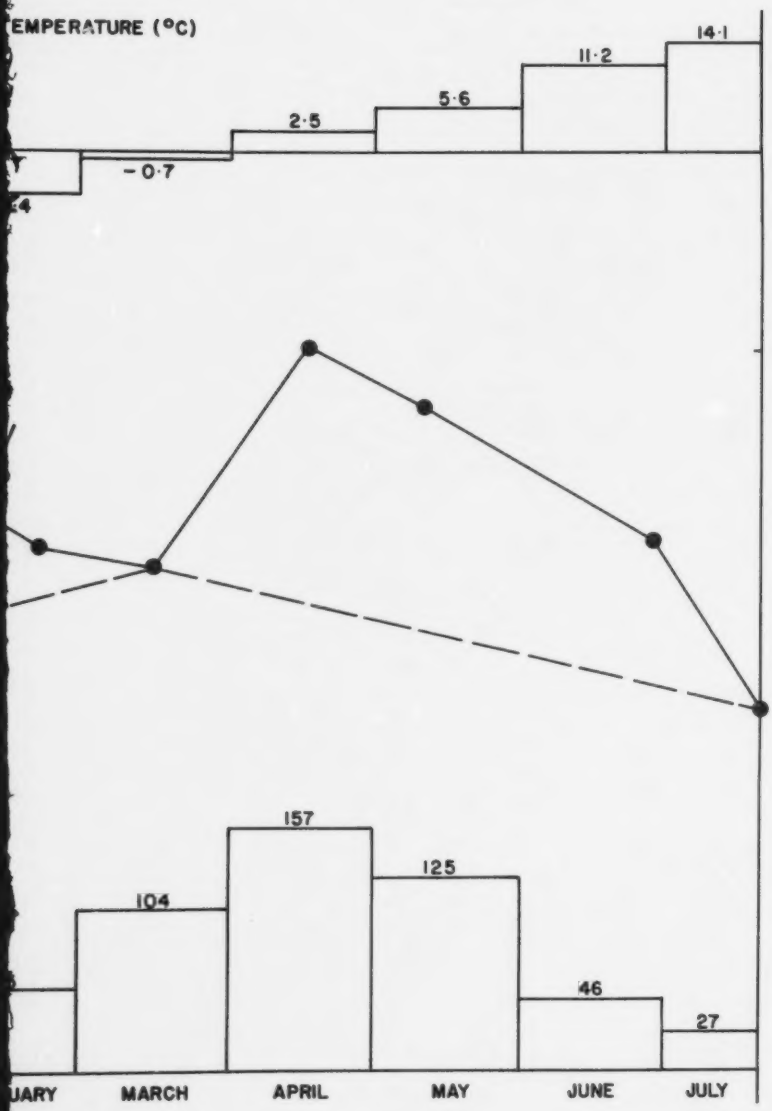

MEAN MONTHLY TEMPERATURE (°C)
14·1
7·7
2·9
-2·0
-3·1
-5·4
-0·7
2·5
STREAM DISCHARGE
(M³/S – cubic metres per second)
1·0
0·1
0·01
26
185
98
224
167
53
104
157
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
TOTAL STREAM DISCHARGE
(MM. ON THE DRAINAGE AREA)



EAM DISCHARGE
DRAINAGE AREA)

Department of Environment
Government of Newfoundland and Labrador

NOTES: a) Hydrograph based on minimum monthly discharge values.

b) Temperature data from the Come By Chance station.

c) 11 month mean temperature 4·2° C.

d) Total stream discharge in mm. on the drainage basin is 1211 mm.

HYDROGEOLOGY OF TRINITY BAY AREA

Figure 5-3
Ground water hydrograph — Come By Chance River
(For mean flow year, 1976-1977)

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c) errors associated with winter stream flow measurements under ice conditions.

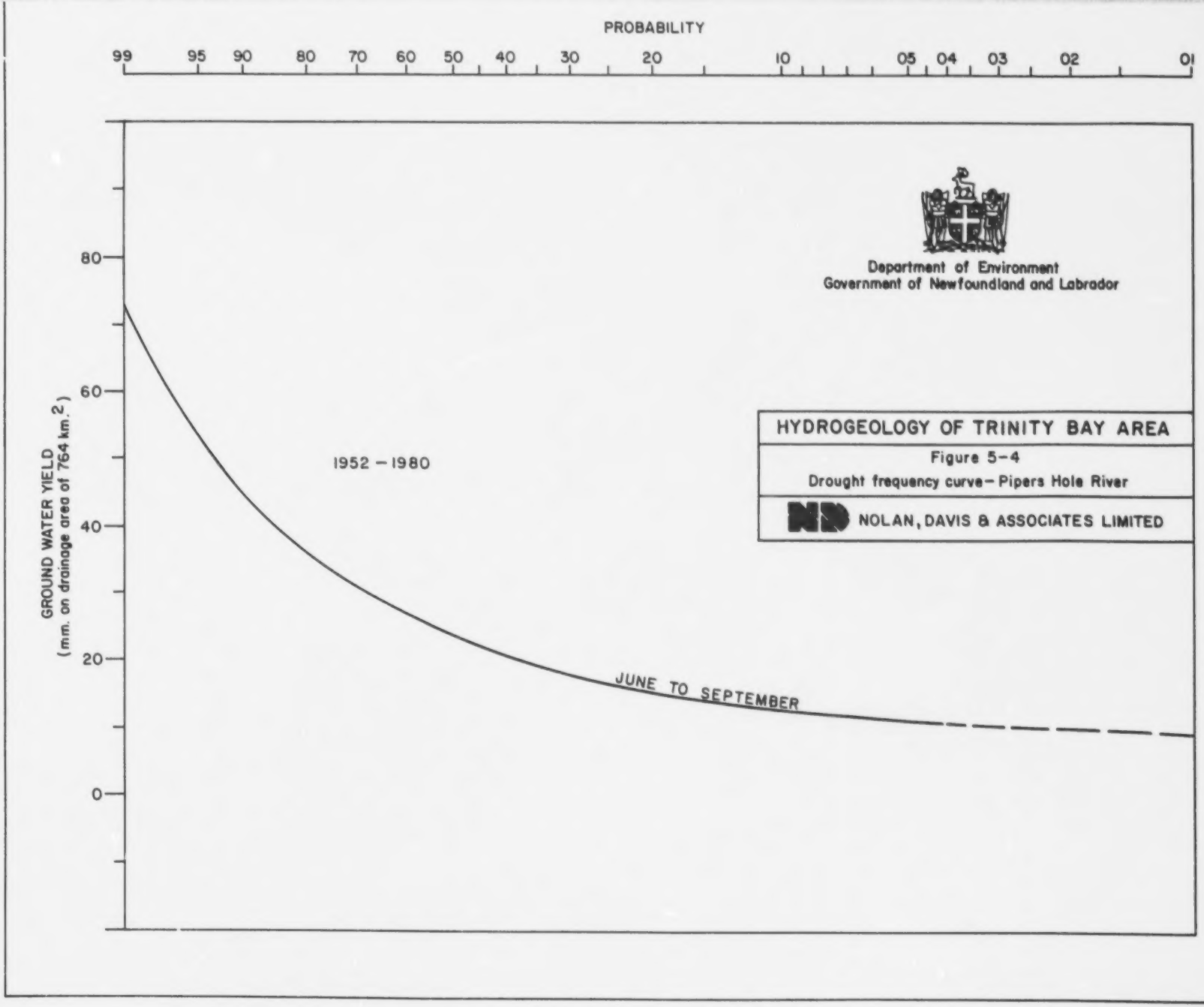
Monthly mean daily temperature data, have been noted in Figures 5-2 and 5-3 as a replacement for precipitation data, in order to give a feeling for timing of snowmelt, etc.

Based upon the preceeding discussions in Section 4, as well as the hydrological statistical methods utilized, it is felt that the ground water discharge values obtained from the "mean" year of record would provide a reasonably conservative estimate.

Therefore regional ground water recharge over this sedimentary-igneous geological unit should be in the range of 106 - 178 mm/yr (4.2 - 7.0 in/yr). Further it is felt that the Pipers Hole River estimate of 178 mm/yr is more reliable due to problems encountered with the "Labrador" pattern present in the Come by Chance River data.

5.3 Availability of Base Flow to Surface Water Users

Within the Hydrologic Cycle, ground water can be readily obtained below ground surface via wells or from a surface water channel via base flow. To determine the


PROBABILITY
99 95 90 80 70 60 50 40 30 20 10 05 04 03 02 01
GROUND WATER YIELD
(m.m. on drainage area of 764 km.²)
80
60
40
20
0
1952 – 1980
JUNE TO SEPTEMBER
Department of Environment
Government of Newfoundland and Labrador
HYDROGEOLOGY OF TRINITY BAY AREA
Figure 5-4
Drought frequency curve – Pipers Hole River
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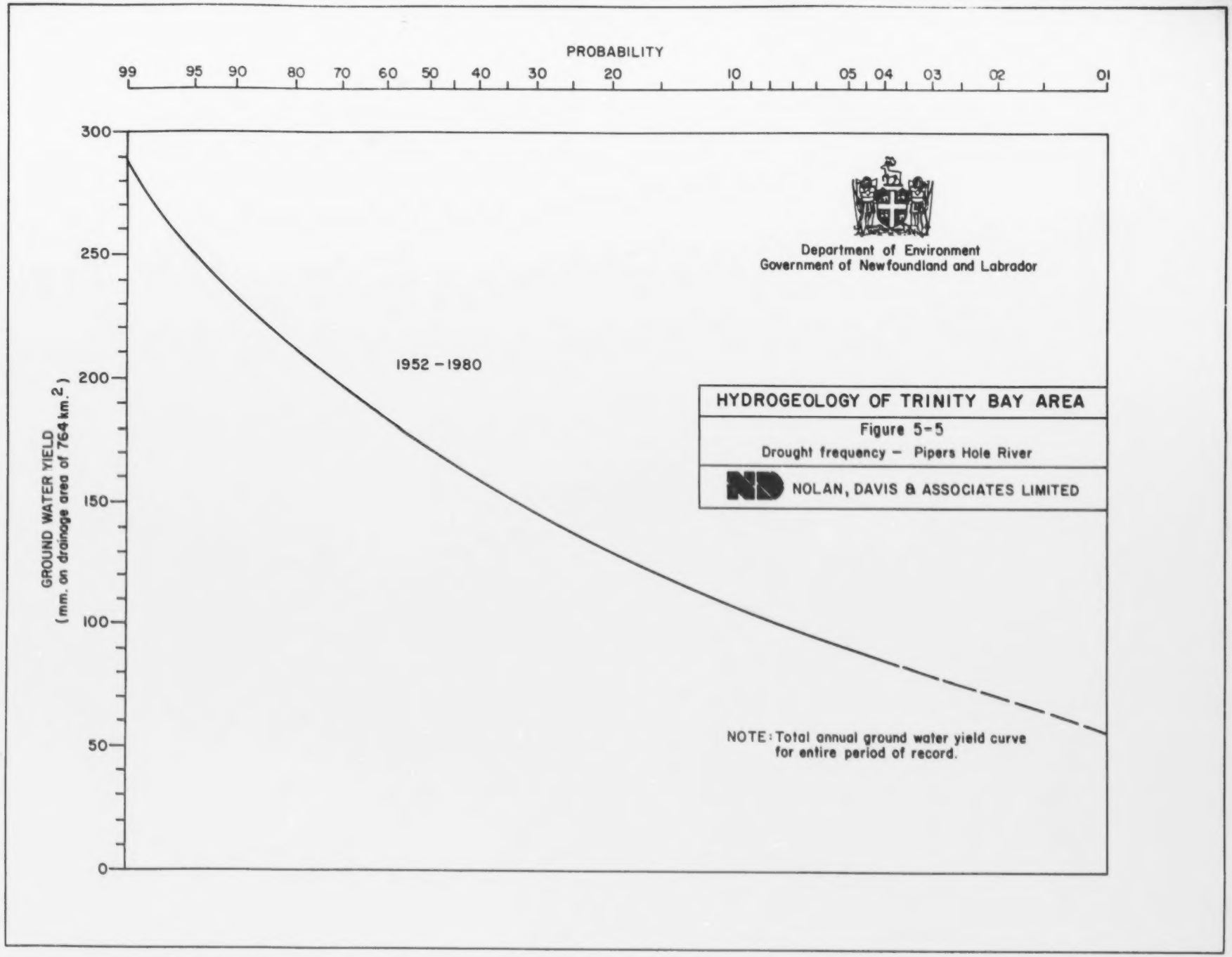
PROBABILITY
99 95 90 80 70 60 50 40 30 20 10 05 04 03 02 01
300
250
200
150
100
50
0
GROUND WATER YIELD
(mm. on drainage area of 764 km.2)
1952 – 1980
Department of Environment
Government of Newfoundland and Labrador
HYDROGEOLOGY OF TRINITY BAY AREA
Figure 5-5
Drought frequency – Pipers Hole River
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NOTE: Total annual ground water yield curve
for entire period of record.

availability of ground water for utilization by dams or reservoirs (i.e. the minimum annual ground water discharge that can be expected), the drought frequency curves were calculated from twenty-five years of records for the Pipers Hole River. These curves are intended to illustrate the probability, and consequently the availability, of a particular ground water discharge volume for surface water users.

The curve for summer ground water yield (four summer months of June - September inclusive) is shown in Figure 5-4 and was calculated by the Pearson Type III method. The graph shows that there is a 4% probability of a yield of 11 mm (.43 in) on the drainage area. The curve flattens out, approaching 10 mm (.39 in) at a 1% probability; but the projection is not reliable. A longer term of record would be necessary to have confidence in such a limit. However, it may be noticed that the curve drops away slowly and at the 2.33 year, the yield is about 21 mm (0.83 in) on the drainage area.

Figure 5-5 indicates the curve for the total annual ground water yield. The graph indicates a 4% probability of a yield of 85 mm (3.3 in) on the drainage area of the Pipers Hole River.

6 WATER QUALITY

6.1 Ground Water

6.1.1 Introduction:

Precipitation falling to the ground generally contains very low concentrations of dissolved minerals. Once this water passes into the soil zone, it begins its geochemical evolution. Often the reactions within this zone will have a substantial influence on the ground water chemistry further along the flow system. Within the soil zone, carbonate reactions leading to the production of H_2CO_3 (carbonic acid) dominate. Together with organic acids produced in this zone, H_2CO_3 will play a major role in the dissolution and transport of minerals from the soil profile to the water table or saturated zone (Freeze and Cherry, 1979). As ground water moves along its flow path, increases in both TDS (total dissolved solids) and major ions can generally be expected. Ultimately, the chemical evolution of any ground water will be controlled by:

a) the geologic units through which the ground water passes

b) the length of the flow system from recharge to discharge zone

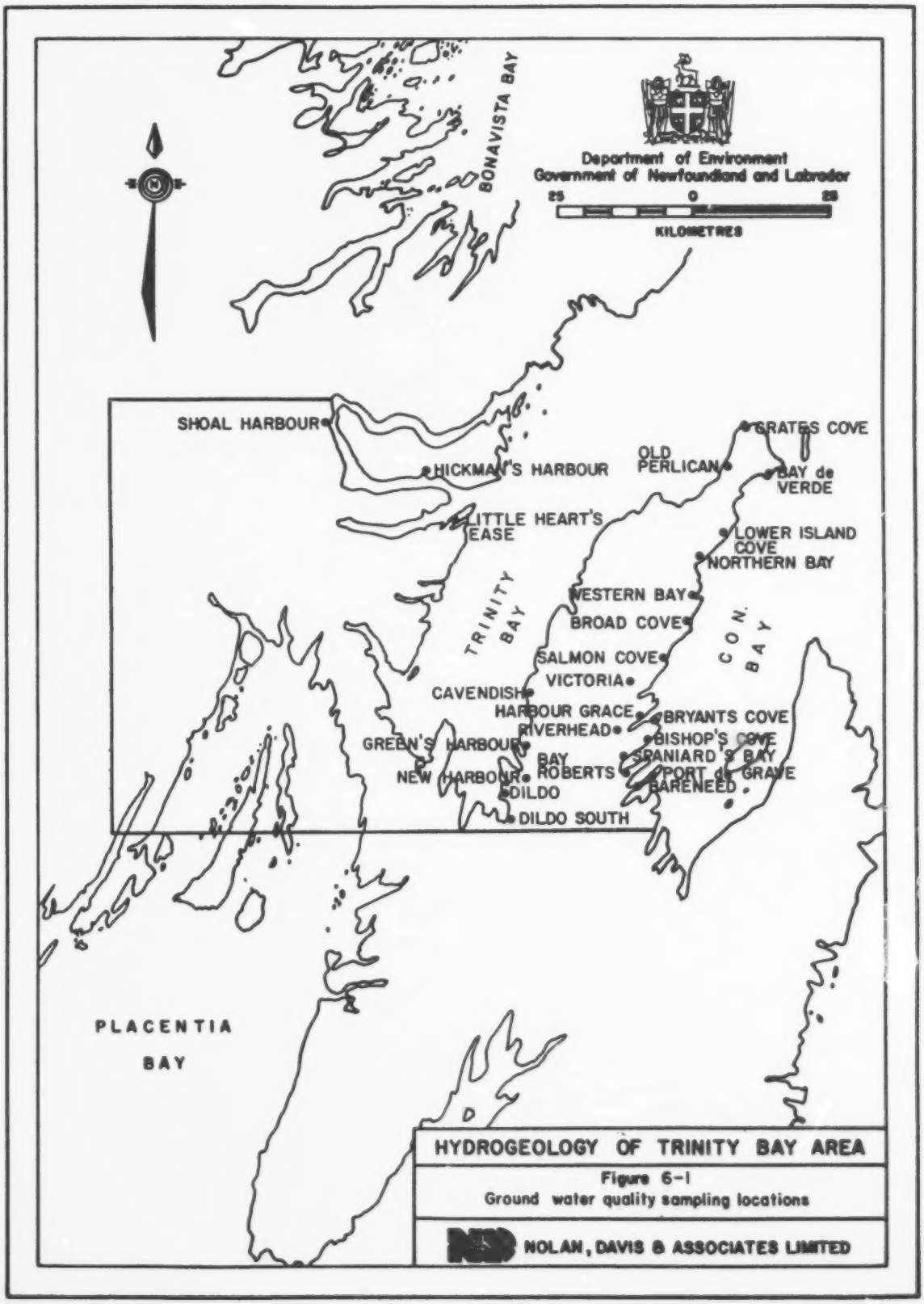
c) the time required to move through this flow system.

Ground water moving through a short, shallow flow system will be substantially different from a ground water moving through a deep regional flow system.

6.1.2 Assessment of Data:

A total of 55 complete or semi-complete major ion samples were available and utilized for the Trinity Bay study area. Of these, 43 samples were obtained from Nolan, Davis and Associates (including all complete chemistry samples); various provincial agencies, including the Departments of Environment, Municipal Affairs and Housing, and Public Health provided 12 samples; and 3 samples were collected by Environment Canada. Most of the group of 43 samples were collected during aquifer tests, consequently, most samples were collected directly from the well following a period of pumping.

Appendix C lists the available data according to geologic units while Figure 6-1 indicates sample locations. A complete analysis is defined as one in which the major ions - sodium, potassium, calcium, magnesium, alkalinity, sulfate and chloride (Na, K, Ca, Mg, Alk, SO_4 and Cl respectively), have been determined. An analysis without any one of these parameters is considered as semi-complete. Generally, the fewer major ions analyzed, the less useful the analysis. An analysis with a total of six or eight parameters, including one or two major ions, is considered as a partial analysis.


BONAVISTA BAY
Department of Environment
Government of Newfoundland and Labrador
25 0 25
KILOMETRES
SHOAL HARBOUR
HICKMAN'S HARBOUR
LITTLE HEART'S EASE
TRINITY BAY
GRATES COVE
OLD PERLICAN
BAY de VERDE
LOWER ISLAND COVE
NORTHERN BAY
WESTERN BAY
BROAD COVE
SALMON COVE
VICTORIA
CAVENDISH
HARBOUR GRACE
RIVERHEAD
GREEN'S HARBOUR
BAY ROBERTS
NEW HARBOUR
DILDO
DILDO SOUTH
CON BAY
BRYANTS COVE
BISHOP'S COVE
SPANIARD'S BAY
PORT de GRAVE
BARENEED
PLACENTIA BAY
HYDROGEOLOGY OF TRINITY BAY AREA
Figure 6-1
Ground water quality sampling locations
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A brief discussion of selected chemical parameters and their importance to ground water chemistry, is available in Appendix D.

An approximately equal number of partial analyses was available from the previously mentioned sources, but were not used because of:

a) the incomplete nature of the analysis
b) the lack of indication as to the location and/or source (ground or surface water) of the analysis
c) in some cases, the analysis represented "problem" conditions, not normal ground water chemistry.

Generally for the partial analyses, little or no information was available on one or more of the following - well characteristics, including depth, sample collection techniques and sample handling/preservation.

Several chemical analyses were available for the Trinity Bay study area from the Shawinigan and MacLaren (1968) study. These analyses were not incorporated in this work because:

a) the Na and K values were not measured analytically, they were calculated on the basis of mass balance considerations
b) the sample collection procedures were not indicated

c) in some cases, the analyses represented "problem" conditions, not normal ground water chemistry.

Unfortunately only 29% (i.e. 16) of the 55 samples have complete major ion chemistry. All 16 samples, with one exception, had mass balances within quite acceptable limits (<5%). These samples originated from drilled bedrock wells located in various communities throughout the study area (see Figure 6-1).

Assignment of the water chemistry data to various geologic units, is based entirely upon the bedrock geology map and the geologic units underlying the various communities. Unfortunately, most geologic units within the Trinity Bay area have no ground water chemistry information, in fact, only the Hodgewater, Musgravetown and Connecting Point Groups have associated ground water chemistry data. Consequently, no attempt was made to classify most of the hydrostratigraphic or geologic units with regard to their ground water chemistry. Where it existed, the ground water chemistry data was discussed in relation to forementioned geologic units. Appendix C summarizes the data as completely as possible.

6.1.2.1 Hodgewater Group:

Of the available water quality data, including the 16 complete major ion analyses, 84% are associated with the

Hodgewater Group. Based on the Trilinear plot of these 16 analyses, it is possible to classify the samples as representative of a Ca-HCO_3 (calcium bicarbonate) type water (see Figure 6-2). From the data plot of Figure 6-2, the following statements can be made:

a) alkaline earth constituents exceed alkalines

b) weak acids exceed strong acids

c) carbonate hardness exceeds 50%

It is probable that the remainder of the 55 analyses (i.e. 39 samples) could generally be considered as Ca-HCO_3 or, in a limited number of cases, Na-HCO_3 type waters.

Based on the available analyses, the water quality within the Hodgewater Group can be considered as fair to good. Typically, this ground water can be considered as "soft" to "moderately hard" with respect to its hardness (classification according to Hem, 1970); while values for TDS can be considered as "low" to "moderately high" based on a value of 500 mg/l (maximum acceptable concentration, established by Health and Welfare Canada - 1978). Table 6-1 contains recommended maximum acceptable values for selected parameters.

By far, the most serious problem is the large percentage of wells that have excessive manganese values. Actually, 76% of the analyses exceeded the 0.05 mg/l limit

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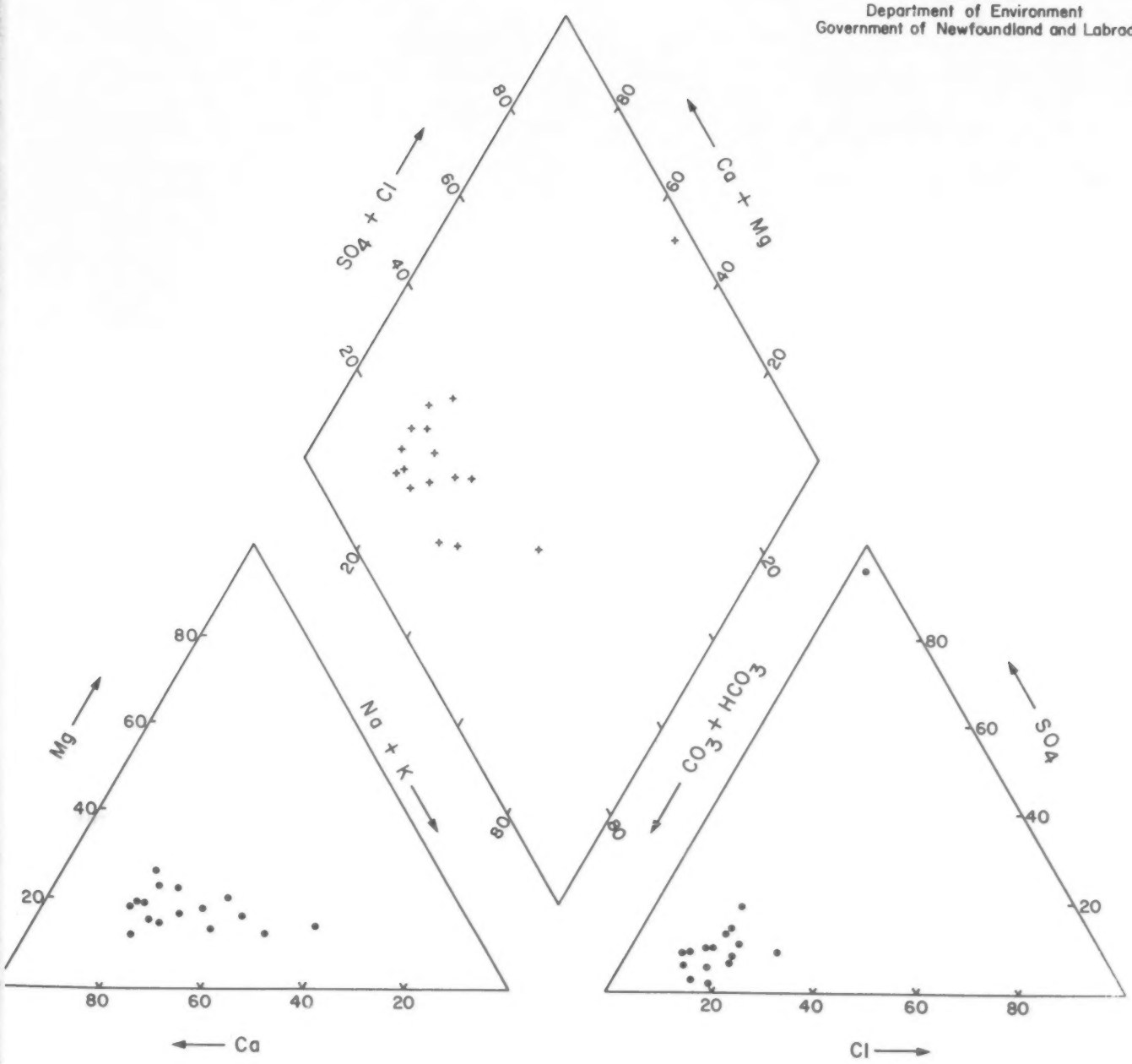

Per cent of total equivalents per million

HYDROGEOLOGY OF TRINITY BAY AREA
Figure 6-2 Hodgewater chemical data
NOLAN, DAVIS & ASSOCIATES LIMITED

TABLE 6-1

RECOMMENDED LIMITS FOR SELECTED PARAMETERS *

PARAMETER	MAXIMUM ACCEPTABLE CONCENTRATION
Calcium	No recommended limit
Magnesium	No recommended limit
Potassium	No recommended limit
Sodium	20 mg/l - suggested limit for people on sodium restricted diets
Sulphate	500 mg/l
Chloride	250 mg/l
Hardness	80 - 100 mg/l is considered optimum
Nitrate (as N)	10.0 mg/l
Nitrite (as N)	1.0 mg/l
Phosphate	No recommended limit
Fluoride	1.5 mg/l
Iron	0.3 mg/l
Manganese	0.05 mg/l
Copper	1.0 mg/l
Lead	0.05 mg/l
Zinc	5.0 mg/l
Cadmium	0.005 mg/l
pH	6.5 - 8.5
Color	15 TCU
TDS	500 mg/l
Turbidity	5 NTU or JTU
Conductivity	No recommended limit

* based on Health and Welfare Canada (1978), "Guidelines for Canadian Drinking Water Quality".

whereas iron values exceed the 0.3 mg/l limit in only 26% of the samples. Both these parameters are major nuisance constituents in many ground waters and may be accompanied by elevated values in parameters such as color, turbidity and conductivity.

In several instances the values for chloride are elevated or exceed the 250 mg/l limit (samples 4, 5, 6, 8, 9, 10, 20 and 41). With increases in chloride, the ionic strength of a ground water is increased, consequently the solubility of other parameters such as iron, manganese and nitrate will be enhanced. Many of these forementioned samples are from Bay de Verde (samples 4, 5, 6, 7, 8 and 9); this suggests the existence of contamination probably related to marine aerosols, road salt or sea water intrusion.

Also worth noting are increases in trace metals such as copper, lead, zinc and cadmium, as indicated by several samples (Samples 10, 27 and 40). Without further information on the sample source and collection procedures, the cause of such elevated values cannot be determined, however, elevated values for copper and zinc are sometimes related to the plumbing system. The increased values for cadmium are unusual and may be related to elevated values of other parameters that were not analyzed such as chloride.

6.1.2.2 Musgravetown Group:

Five of the available ground water analyses are located within the Musgravetown Group. Due to the incomplete nature of the analyses, very few meaningful comments can be made (see Appendix C). Values for TDS can generally be considered as "low" to "moderate" although in one instance (sample 51) the 697 mg/l value exceeds the 500 mg/l limit - the elevated chloride value in this sample is probably responsible. All manganese and most iron values are within the limits of the maximum acceptable concentrations. Based on these 5 analyses, iron and manganese would appear to represent minimal "nuisance" components in Musgravetown Group ground water samples. Two samples (50 and 51) have elevated chloride values, both are located in Shoal Harbour, the reason for these increased values may be related to sea water intrusion, road salt problems or possibly marine aerosols. With respect to hardness, the analyses indicate that the ground waters in this group can be considered as "soft" to "moderately hard".

6.1.2.3 Conception Group:

This geologic unit contains only 4 of the available analyses. Again, the incomplete nature of the data restricts the comments that can be made. The samples can be considered as "moderate" to "high" in terms of the 500 mg/l TDS limit.

In nearly all samples, the manganese values exceed Health and Welfare Canada (1978) maximum acceptable concentration while excessive iron values are apparently less of a problem. Consequently, "nuisance" type problems related to excessive manganese values can be expected. Hardness values for this group range from "moderately hard" to "very hard".

6.2 Surface Water

Available surface water quality data originates from two distinct monitoring programs:

a) case type: infrequent and/or spot sampling at a variety of locations for individual studies

b) ambient trend monitoring: frequent sampling at designated locations as part of the Newfoundland and Labrador, Department of Environment's provincial water quality network.

For determination of base flow quality, which is primarily controlled by ground water, only the ambient trend monitoring provides sufficient data and is discussed further.

There are two water quality network stations located within the study area (see Figure 5-1). One is located at Spout Cove Brook (water quality station No. 5, with a watershed area of 10.8 km^2/4.2 mi^2) and the second at Hearts Content River (water quality station No. 6, with a watershed

area of 91.9 km^2/24.4 mi^2). Sampling commenced at both stations in June 1977 with a frequency of approximately one sample per month. The stations are still active. The number and type of parameters monitored varies with each sample.

Both watersheds are underlain by Upper Precambrian continental facies rocks of the Hodgewater Group (Hydrostratigraphic Unit 4) which principally consist of siltstone, arkose and slate with minor conglomerate. The bedrock is generally overlain by a thin, patchy blanket of ground moraine/ablation till which is probably sandy in texture. The simplicity of geological conditions facilitates the hydrogeological interpretation of the Hodgewater Group. However, the geological similarity and the proximity of the two watersheds on the Bay de Verde Peninsula, restricts the ability of extrapolating the data spatially within the same hydrostratigraphic unit, or to other units within the study area.

Further restrictions on data interpretation are emphasized by alterations in base flow chemistry, due to limnological conditions upstream of both stations, lack of simultaneous discharge data, and sample validity. In regards to the latter, only 18% of the samples have a full major ion analysis. Of these, large errors (4 - 61%, mean 20%) in the mass balances were noted and believed due to a combination of low TDS (3 - 58 mg/l, mean of 23 mg/l) and analysis being

completed on unfiltered samples.

6.2.1 Water Chemistry:

From the available data, several comments can be made on the baseflow chemistry originating from discharging streams within the Hodgewater Group. The Hearts Content and Spout Cove stations consistently record a fresh, soft, corrosive Na-Cl type water, generally with a 4.5 - 6.5 range in pH. However this does not resemble the Ca-HCO_3 type water found in drilled wells of this unit (Section 6.1.2.1). The discrepancy may, in part, be due to the fact that the wells are concentrated along the coast whereas the stream data is more indicative of inland, higher elevation regions. Inland lies the Hodgewater Group, however, it is comprised of continental clastic rocks; this eliminates the possibility of marine evaporates underlying the headwaters of the two streams. The Na-Cl typing would therefore seem to be a function of the predominance of marine aerosols in precipitation, due to the proximity of the Atlantic Ocean. This further implies either:

A. The Hodgewater Group in the area is relatively impermeable, this creates a large surface runoff or interflow in the more heavily fractured upper bedrock surface which results in little chance for flow to dissolve further constituents. This is supported by:

a) negligible increase in TDS with a nine fold increase in basin size between the two rivers

b) thin to absent drift cover on the interior of the Carbonear Plateau

c) a low TDS (mean 20 - 25 mg/l) being only slightly elevated above the TDS (5 - 15 mg/l) in precipitation recorded at Gander Airport and Stevenville climatic stations

d) relatively low concentrations of Ca, Mg, alkalinity, Fe and Mn for flow through continental sedimentary rock types.

B. In this area, the Hodgewater Group supports a localized "fast response" type ground water flow system. This hypothesis is supported by the existence of fracture flow, relatively steep topographic gradients and the discussions previously presented (Section 4.2.3.4). The reasons for this discrepancy are not fully understood due principally to the lack of more detailed, higher quality data.

There are no major well defined seasonal or annual trends indicated by the water chemistry data.

6.2.2 Water Quality:

The data from the provincial water quality network enables the following comments to be made on the surface

water quality:

a) Nearly all parameters analyzed meet the Health and Welfare Canada (1978) maximum acceptable concentrations. The pH ranges from 4.5 - 6.5 and is the parameter that most frequently exceeds the established limit (see Table 6-1). Infrequently color which ranges from 5 - 40 TCU exceeds the Health and Welfare Canada (1978) limit.

b) Total coliform bacterial counts generally range from 0 - 100/100 ml, while fecal coliform counts of 10 - 20/100 ml occur with much less frequency. These values are within the range expected in natural wooded conditions. However, the values exceed Health and Welfare Canada (1978) limits and may dictate that water treatment would be required.

7 POTENTIAL AND EXISTING CONTAMINATION PROBLEMS

This chapter will deal only with man-made or man-influenced contaminant problems, It is important to note that ground water contamination can also result from naturally occurring mineralized sources and may produce problems related to excessive values of iron and manganese (as discussed

in Section 6.1.2), arsenic, fluoride, radio-nuclides, etc.

7.1 Sewage Effluent

This includes discharges from septic tanks, septic disposal fields and pit privy systems although use of the latter is very restricted within the Trinity Bay study area. Such systems produce a variety of contaminants, the more notable of which include total solids, BOD, TOC, COD, ammonia, kjeldahl nitrogen, chloride, sodium, iron, increased alkalinity, conductivity, total and fecal coliform bacteria (Brandes, 1977). Ground water contamination problems that arise are frequently related to the presence of nitrogen - usually as nitrate and ammonia, phosphate, chloride and bacteria.

On-site septic disposal systems function properly in areas where a sufficient thickness of reasonably permeable overburden or soil exists. Generally, most parts of the study area do have sufficient thickness of overburden to facilitate the use of septic disposal systems. However, exceptions do exist in the Bay de Verde and Port de Grave areas (N. Gosse, Inspector - Department of Public Health, personnel communications). In these forementioned areas, the prevalence of exposed bedrock and bog deposits are the main reasons for lack of septic system suitability. Locally,

problems will arise when the downward overburden/soil permeability is low, as in areas of clay deposits. Septic disposal systems should always be located down-gradient of adjacent wells. Still, it should be noted that even systems located down-gradient, can cause problems if they are within the hydraulic influence of a pumping well.

In some coastal locations within the Trinity Bay study area, septic disposal systems drain directly into the ocean. This practice is restricted to older homes that historically utilized this method of disposal; current Public Health regulations will not permit this method of disposal. Almost certainly there exist cases in which it is the only practical method of septic disposal, consequently it is utilized.

Most often contamination problems related to septic systems will effect shallow dug wells. Rarely is a contamination problem encountered with a drilled well. Within the study area the contamination of shallow dug wells is primarily related to the lack of proper well construction.

7.2 Well Construction

Contamination of both dug and drilled wells is frequently attributed to or associated with well construction

in the Trinity Bay study area. Contamination in one well, through poor construction practices, can frequently serve as a point source of contamination for surrounding wells.

The use of dug wells, both in the past and present, is widespread. Many of the dug wells in the study area, especially in the smaller centers, are quite old. The number of dug wells that could be considered as "properly" constructed is likely to be small either because of economics, traditional precedent, or logistics (i.e. overburden too thin, etc.). In some areas, the dug well consists of a covered bedrock spring or a bedrock depression/excavation into which surface and shallow ground water can collect. This has produced dug wells that:

a) are not properly lined or gravel packed
b) have no concrete or cement apron around them
c) have tops which are level with the ground surface
d) have no tops or are not properly covered
e) are not situated properly with respect to possible contaminant sources
f) are not checked, cleaned or maintained on a regular basis.

In many instances it is only their rural setting that ensures these dug wells operate unaffected by contamination.

Drilled wells are generally, but not necessarily,

less susceptible to various contaminant sources. Proper construction techniques are perhaps more important for drilled wells when one considers the cost involved. Generally problems with drilled wells will arise because:

a) an insufficient amount of casing is used during construction
b) driveshoes are not used to seal the casing tightly into the bedrock
c) improper welding of casing joints has produced leakage
d) the annular space or fracture zones around the bottom of the casing have not been cement grouted to ensure a tight seal within the bedrock
e) well seals are not used or are used improperly.

The most evident problem within the study area, based on the drilled well records, is the use of insufficient casing. In many cases less than 6.1 m (20 ft) is used during well construction. This is especially but not always true for wells that are at least 10 years old. Typically, most upper bedrock surfaces are extensively fractured and unless casing is installed below this fractured surface, contaminants that may reach it cannot be prevented from entering the well through interconnected fractures.

7.3 Road Salt

The use of salt and salt/sand mixtures for winter de-icing purposes, has frequently resulted in chloride and/or sodium contamination of shallow dug wells and to a lesser extent drilled wells. The potential for occurrence of such problems within the Trinity Bay area has been increased by:

a) the prevelence of ribbon-type housing development
b) the construction characteristics of wells - especially dug wells
c) the practice of locating wells close to the road
d) the thinness of surficial materials.

Depending on the nature of the flow system, down-gradient contamination of wells may not occur for months after road salt applications have stopped, as contaminants are flushed through the flow system. Chemically it is difficult to distinguish between chloride and sodium produced by road salt, sea water intrusion, marine aerosols or natural ground waters from salt bearing geological formations.

Throughout the study area an estimated 15 - 20 possible road salt contamination cases are received each year by the provincial Department of Transportation (DOT). A number of these complaints are not considered legitimate by DOT since they involve wells that have been installed after

current road de-icing practices were implemented - this situation prevails in most of the study area within the Avalon Peninsula (E. Hettasch, District Highway Manager - DOT, personnel communication). The complaints usually involve dug wells located on the down-gradient side of a paved road (often a newly paved road) and are most prevalent in the spring.

Annually throughout the study area, an estimated 22,000 tonnes (21,652 tons) of predominantly salt, and to a lesser extent, sand/salt is used for de-icing. The latter is used almost exclusively on unpaved roads, generally, at mixtures of 15%/85% or 34%/66% salt/sand respectively.

7.4 Sea Water Intrusion

This potential problem is of obvious concern when wells, particularly drilled wells, are being constructed along the coast. It should be more of a concern in the heavily populated portions of the study area, especially the west coast of Conception Bay. The likelihood of a well encountering this problem is usually dependent upon one or more of the following factors:

a) the well's proximity to the coast
b) the depth of the well
c) the dip of the geologic formation
d) the position of fracture zones within the well

e) the pumping rate.

As previously discussed, local flow systems will probably predominate along the coast and will direct ground water flow toward the sea. The potentiometric head acting on most coastal wells, as a consequence of higher topographic elevations inland, may be sufficient to prevent encroachment of sea water to the well. However, depending on the pumping rate and proximity to the coast, reversals in the hydraulic gradient may occur and sea water could be induced into a well (or wells). Decreasing the pumping rates; driving the casing deeper, to seal off sea water bearing formations or fracture zones; and grout sealing of such zones, may be utilized in dealing with sea water intrusion problems.

During development of ground water systems for coastal communities, encouragement should be given to seek well locations as far inland as practical. Sea water intrusion has, apparently, not been a problem within the Trinity Bay area, although there are many coastal population centers that depend on ground water as a sole source of supply.

7.5 Chemical and Hydrocarbon Contamination

Generally this type of problem is not of major concern within the Trinity Bay area, although locally problems

have arisen. A recurring problem within some parts of the study area, involves contamination associated with hydro and/or telephone poles which are heavily treated with creasote (N. Gosse, Inspector - Department of Public Health, personnel communication). Most reported cases involve a single dug well that is located down-gradient of a newly installed creosote treated pole; less frequently three or four dug wells may be affected. The Department of Public Health generally handles these problems with the full cooperation of the public utility concerned. Based on this type of complaint, it is reasonable to conclude that storage yards for such treated poles or the yards in which the creosote is applied, are also potential point sources for contaminants that could impare the quality of down-gradient wells.

Occasionally problems concerning spills of domestic heating oil supplies or leakage from underground gasoline storage tanks are also encountered. The former cases would usually involve 227 to 455 litres (50 to 100 gallons) of heating oil from storage tanks. Often the cause involves collapse of the support structure holding the tank in place, the tank bottom rusting out, or a broken feed line. These oil or gasoline spills can ruin either individual or communal water supplies for tens of years. The presence of thin, permeable surficial deposits and/or the dominance of fracture flow, means there will be little to retard the vertical or

lateral migration of such hydrocarbons. Proper siting of domestic oil tanks and periodic inspection, maintenance and installation of seepage detection devices on gasoline tanks, will reduce such hydrocarbon spills.

Today the handling and use of hazardous and toxic chemicals is almost an everyday occurrence. Some of these chemicals such as pesticides, herbicides, de-greasing agents, PVC's, etc. are toxic in concentrations of mg/g (approximately equal to ppb). Consequently, even a small spill measured in tens of litres can permanently destroy the usefulness of an aquifer over large areas. Persons handling or working with such chemicals should be instructed in the potential dangers associated with them, to ensure their proper handling and storage.

In the event of either a hydrocarbon or chemical spill, only immediate action will provide an opportunity to limit the resulting effects on ground water. Clean-up procedures should include immediate excavation and removal of contaminated surficial material and establishment of an hydraulic gradient, through pumping, to control lateral and possibly vertical migration of the contaminant. Construction of a trench down-gradient of the spill site, may also help to limit the migration of any contaminants moving in the surficial materals.

7.6 Solid Waste Disposal Leachate

All solid waste disposal facilities (sanitary landfills, modified landfills, "dumps", etc.) produce a fluid by-product referred to as leachate. This fluid is produced by precipitation that migrates downward, through the surficial materals, dissolving soluable organic and inorganic components of the waste material and the evolution of dissolved gases, such as H_2S and CH_4, during decomposition of organic materials. This leachate will eventually enter the water table and be carried along in the direction of natural ground water flow. The chemical composition of leachate will vary according to the nature of the waste material. Depending on the type of geologic materials and the chemical character of the ground water, attenuation of the leachate is possible. Proper site selection, design, and maintenance of such disposal facilities, will minimize the effect on surrounding ground water supplies.

Typically waste disposal within the Trinity Bay area, as well as much of Newfoundland, is accomplished by burning. The lack of overburden and generally high water table conditions have served to promote this method of waste disposal. Consequently the use of burial techniques for solid waste disposal have been restricted with the study area.

Until quite recently, unrestricted dumping was prevalent in many parts of the study area. However this situation has generally been brought under control (J. Barry, Inspector - Department of Public Health, personnel communication). The trend has been towards establishment of regional sites. However, the lack of sufficient operating funds has hampered the operating practices at some of these disposal sites.

8 CONCLUSIONS

Widespread use is made of ground water throughout the study area. The ground water resource is most extensively exploited through dug wells while utilization of drilled wells, though broad, is concentrated on the west side of Conception Bay. At least seven communities within the Trinity Bay area depend entirely or partially on ground water as a source of supply. No annual inventory is maintained for the dug wells while current information on drilled wells has not been updated.

The information on surficial aquifers in the Trinity Bay study area is very limited. Only a few drilled wells are

known to exist throughout the study area; consequently, the surficial hydrostratigraphic units could only be classified on a qualitative not quantitative basis. The glaciofluvial deposits, which consist of outwash sands and gravels, comprise Hydrostratigraphic Unit S2 - this unit offers the best ground water yield potential. Although yields in excess of 227 lpm (50 gpm) are possible in these types of materials, well construction, well development and the saturated thickness will ultimately control the productivity of this unit.

Within the bedrock, Hydrostratigraphic Unit 4 is the most productive and widely utilized aquifer unit. This unit is comprised entirely of Hodgewater Group sedimentary rocks primarily siltstone, arkose, slate and minor conglomerate. It offers excellent potential to meet any domestic ground water needs and limited industrial, commercial or municipal needs. Yields for these latter purposes, will require the use of more sophisticated siting, well construction/development and testing techniques, than those currently utilized. Over 60% of the drilled bedrock wells have been installed within this unit. The mean yield is 33.2 lpm (7.3 gpm) from a mean depth of 44.8 m (147 ft). The results of 50 very short term aquifer tests indicate a mean yield of 49.6 lpm (10.9 gpm) within Hydrostratigraphic Unit 4; it generally supports the less accurate yield estimates provided by the drilled well records. The ground water yields

within this unit range from 2.3 - 454.6 lpm (0.5 - 100 gpm). This unit primarily underlies the Carbonear Peninsula and the heavily populated western coast of Conception Bay.

Domestic ground water needs can be met by Hydrostratigraphic Units 2 and 3 while Unit 1 can be expected to meet moderated domestic demands. Only the former two units have any potential for meeting limited non-domestic use. The mean yield and depth values for Hydrostratigraphic Unit 2 are 23.2 lpm (5.1 gpm) and 54.0 m (177.3 ft) respectively. For Hydrostratigraphic Unit 3, the mean yield and depth values are 29.5 lpm (6.5 gpm) and 53.5 m (175.4 ft) respectively. The values for Unit 3 are based on information from 12 wells.

Hydrograph records for the Pipers Hole and Come by Chance River basins were examined, although only the former has a lengthy record, to quantify the ground water recharge available to river basins within the Trinity Bay area. Mean ground water recharge values (on the drainage basin) of 178 and 106 mm (7.0 and 4.2 in) were calculated for the Pipers Hole and Come by Chance River basins respectively. A "Labrador" pattern, which is characterized by high runoff during the summer and low runoff in the winter, is present in hydrometric data for all three stations in the Trinity Bay area. The amount of available ground water recharge,

exceeds the amount of ground water utilized in either basin.

Most ground water quality information was derived from Hydrostratigraphic Unit 4 - the Hodgewater Group. The available information indicates the presence of a Ca-HCO_3 or, less frequently, a Na-HCO_3 type water. Typically, the water quality within this unit can be considered as fair to good. The ground water can be considered "soft" to "moderately hard" in terms of hardness while TDS values are "low" to "moderately high". Over 75% of the wells within this unit report excessive manganese values; manganese is one of the major nuisance constituents in ground waters. Elevated values for chloride and trace metals including iron, were also noted within this hydrostratigraphic unit. Many similar comments can be made about ground water quality data available from the Musgravetown Group. The very limited data from the Conception Group indicates hardness values ranging from "moderately hard" to "very hard" while TDS values range from "moderate" to "hard".

Well construction practices, including the siting of wells, is probably the largest contributing factor to ground water contamination within the Trinity Bay area. The frequency of septic effluent and road salt contamination problems, is related to well construction. Often less than 6.1 m (20 ft) of casing is installed into the uppermost

bedrock surface; this surface can frequently be fractured to greater depths. Contaminants, if present, could be expected to move readily through these fractures into the well.

REFERENCES

Anderson, F.D., 1965 - Belleorum, Newfoundland; Geological Survey of Canada, Map 8-1965, 1 inch = 4 miles.

Brandes, M., 1977 - Characteristics of Effluents from Separate Septic Tanks Treating Grey Water and Black Water from the Same House; Ontario Ministry of the Environment, Pollution Control Branch Publication No. W68, 31 p.

Bruckner, W.D., 1979 - Geomorphology of the Avalon Peninsula, Newfoundland; Government of Newfoundland and Labrador, Department of Mines and Energy, Report 79-4, 42 p.

Environment Canada, 1981 - Historical Streamflow Summary Atlantic Provinces to 1979; Minister of Supply and Services Canada, 188 p.

Freeze, R.A. and Cherry, J.A., 1979 - Groundwater; Prentice-Hall, New Jersey, United States, 604 p.

Gibb, J.E. and McMullin, K.A., 1980 - Regional Water Resources Pictou County, Nova Scotia; Nova Scotia Department of Environment, 81 p.

Gray, D.M. (Editor) 1970 - Principles of Hydrology; Water Information Centre, Port Washington, Long Island, New York.

Health and Welfare Canada, 1978 - Guidelines for Canadian Drinking Water Quality 1978; Minister of Supply and Services, 79 p.

Hem, J.D., 1970 - Study and Interpretation of the Chemical Characteristics of Natural Water; United States; Geological Survey, Water Supply Paper - 1473, 3rd Printing, 353 p.

Henderson, E.P., 1972 - Surficial Geology of Avalon Peninsula, Newfoundland; Geological Survey of Canada, Memoir 368, 121 p.

Jenness, S.E., 1963 - Terra Nova and Bonavista Map-Areas, Newfoundland; (2DE½ and 2C); Geological Survey of Canada, Memoir 327, 184 p.

Hutchinson, R.D., 1953 - Geology of Harbour Grace Map-Area, Newfoundland; Geological Survey of Canada; Memoir 275, 43 p.

Kruseman, G.P. and deRidder, N.A., 1970 - Analysis and Evaluation of Pumping Test Data; International Institute for Land Reclaimation and Improvement, Bulletin 11; 200 p.

McCartney, W.D.
1954 Holyrood, Newfoundland; Geological Survey of Canada, Paper 54-3 (Map with Marginal Notes)

1958 Geology of Sunnyside Map-Area Newfoundland; 1N/13; Geological Survey of Canada 58-8, 21 p.

1967 Whitbourne Map-Area, Newfoundland; Geological Survey of Canada, Memoir 341, 135 p.

Nolan, Davis & Associates Limited, 1969 - present - Various projects conducted within the Trinity Bay study area during this period. Data from an estimated 90 projects were used in this report, consequently they are not listed individually. The reader wishing more information can contact Nolan, Davis & Associates.

O'Driscoll, C.F., 1978 - Harbour Buffett, Newfoundland; Newfoundland and Labrador, Department of Mines and Energy, Mineral Development Division, Map 7873, 1:50,000.

O'Driscoll, C.F. and Hussey, E.M., 1978 - Sound Island, Newfoundland; Newfoundland and Labrador, Department of Mines and Energy, Mineral Development Division, Map 7863, 1:50,000.

O'Driscoll, C.F. and Muggridge, W.W., 1979 - Geology of Merasheen (1M/8) and Harbour Buffett (1M/9E½), Newfoundland; in Gibbons, R.V. (Editor), Report of Activities for 1978; Newfoundland and Labrador, Department of Mines and Energy, Mineral Development Division, Report 79-1, p. 82-89.

Peach, J.A., 1975 - The Tourism and Outdoor Recreation Climate of Newfoundland and Labrador; Environment Canada - Atmospheric Environment Service, Project Report No. 20, Microfische.

Shawinigan Engineering Company Limited and James F. MacLaren Limited, 1968 - Water Resources Study of the Province of Newfoundland and Labrador; Atlantic Development Board, Vol. 2B and 3A.

Thornthwaite, C.W., 1948 - An Approach Toward a Rational Classification of Climate; Geographical Review, Vol. 38, p. 55-94.

Toth, J., 1963 - A Theoretical Analysis of Groundwater Flow in Small Drainage Basins; Journal of Geophysical Research, Vol. 68, No. 16, p. 4795-4812.

Twenhofel, W.H. and MacClintock, P., 1940 - Surfaces of Newfoundland; Bulletin of the Geological Society of America, Vol. 51, p. 1665-1728.

Water Resources Branch
1979 Water Well Data for Newfoundland 1950-1977; Newfoundland and Labrador, Department of Environment, Report 1-1, Vol. 1 and 2, 1010 p.

1982 Hydrogeology of Bonavista Bay Area; Newfoundland and Labrador, Department of Environment, Water Resources Report 2-3, in press.

Williams, H., 1979 - Appalachian Orogen in Canada; Canadian Journal of Earth Science, Vol. 16, No. 3, p. 792-807.

Williams, H., Kennedy, M.J. and Neale, E.R.W.
1972 The Appalachian Structural Province; in Price R.A. and Douglas, R.J.W. (Editors), Variations in Tectonic Styles in Canada; Geological Association of Canada, Special Paper No. 11, p. 182-201.

1974 The Northeastward Termination of the Appalachian Orogeny, in Naira, A.E.M. and Stehli, F.G. (Editors), The Ocean Basins and Margins, Vol. 2, New York, p. 79-123.

Vanderveer, D.G. and Cornish, J., 1977 - Surficial and Glacial - Gravel Resources Inventory Avalon Isthmus Area; Government of Newfoundland and Labrador, Department of Mines and Energy, Open File No. Nfld. 960, 8 p.

APPENDIX A

SURFICIAL DRILLED WELL RECORDS

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
Clarkes Beach	1	Pentecostal Home	02 69		65	4	58		20	DO	0-26 gravel 26-58 sand and gravel
Clarkes Beach	2	D.M.A.H.	06 74		58	6		48	25		0-58.1 sand and gravel
Clarkes Beach	3	Town Council	05 76	05	40		44		25		
Clarkes Beach	4	Carl Hodder	04 75	05	40		40		26		
Clarkes Beach	5	C.P.Wilcox	05 76	05	42		42				
Clarkes Beach	6	Town Council	08 77	04	48	6	50				
Clarkes Beach	7	Tolsen Ralph	07 75	04	47	6	47				
Clarkes Beach	8	S. Garland	12 77	01		6	55				0-50 sand and small boulders
Clarkes Beach	9	Town Council	04 71	05	52		52				
Clarkes Beach	10	Town Council	05 76	05	44		44		25		
Come by Chance	11			01		8					0-62 gravel
Georgetown	12	J. Hodderson	06 78	01		6	45		35	DO	0-45 sand and gravel
North River	13	R.J. Sparkes		02	40		40		2		0-40 overburden
Shoal Harbour	14	D.M.A.H.	75		55	6	46	25	23		0-55 sand and gravel

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Shoal Harbour	15	Town Council	12 76	01	37	6			15-18	MU	0-37 overburden
Shoal Harbour	16	Town Council	07 75	01	97	6			30	MU	0-97 overburden
Shoal Harbour	17	B. Coish	08 75	01	80	6			4	DO	0-80 overburden
South River	18	Conception Bay Int. School Board	07 76	03	28	6	28				
South River	19	H. Butler	07 75	05	45		45		10		

APPENDIX B

BEDROCK DRILLED WELL RECORDS

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Adams Cove	1	D.M.A.H.		09	168	6		10.5-13	7.25		
Adams Cove	2	D.M.A.H.	04 72		250	6					0-48 overburden 48-250 bedrock
Adeyton	3	Wesley Stringer	11 80	04	280		43		.25		
Arnolds Cove	4				100						
Arnolds Cove	5				100						
Arnolds Cove	6	D.M.A.H.	04 68	05	222		73				
Arnolds Cove	7	Can. National Railway	08 77	01	210		22		1	IN	0-5 gravel 5-210 shale
Bareneed	8	Hazel Bartlett			70	6		35			0-40 overburden 40-70 bedrock
Bareneed	9	Cyril Boone	05 75	05	185		56		2.5		
Bareneed	10	Clarence Andrews	10 73	05	140		37				
Bareneed	11	Baxter Bishop	03 73	05	100		43		3		
Bareneed	12	R. Andrews	02 73	05	220	6	31		2		
Bareneed	13	Jim Hussey	11 73	05	65	6	30				
Bareneed	14	J. J. Hussey	04 73	05	250		23				
Bareneed	15	John Bartlett	06 73	05	170		41				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Bareneed	16	Jason Enterprises	05 75	05	265		25		6.5		
Bareneed	17	Fish Plant	05 75	05	265		18				
Bareneed	18	Jason Enterprises	06 76	05	280						
Bareneed	19	C. Boone	05 75	05	40		40				
Bareneed	20	Fish Plant		05	350		48		6		
Bareneed	21	John Efford	08 76	04	249	6	12				
Bareneed	22	George Pye	02 75	05	110		20		2		
Bareneed	23	B. Piercey	06 77	05	210		34		2.5		
Bareneed	24	Conception Bay Builders	06 76	04	64	6	24				
Bareneed	25	Fish Plant	02 76	05	200		46				
Bay de Verde	26	D.M.A.H.	73		289.6	6		184.9	0.5-1		
Bay de Verde	27	Moses Blundon	11 76	01	300	6			3	DO	0-13 overburden 13-300 bedrock
Bay de Verde	28		03 73	03	170	6	22	8	3		
Bay de Verde	29	D.M.A.H. Tucker									
Bay de Verde	30	D.M.A.H. Saunders									

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Bay de Verde	31	Clyde Coish	10 76	01	45	6			2	DO	0-11 overburden 11-45 bedrock
Bay de Verde	32	School	08 65	09	106		17				
Bay de Verde	33	Quinlon Bros	04 65	03	100		20.5				
Bay de Verde	34	R.J. Noah & Sons	07 67	03	123	8	28				
Bay de Verde	35	Gene Noonan	12 64	03	123	6	14				
Bay de Verde	36	J. Noonan	11 76	03	165		22	55	3		
Bay de Verde	37	Quinlan Bros	05 69	03	165	6	24	20	6		
Bay de Verde	38	Paul Emberley	08 72	03	90		12				
Bay de Verde	39	Donald Barter	11 69	03	90	6	27				
Bay de Verde	40	Quinlan Bros	01 68	03	90	6	18	22	6		
Bay de Verde	41	Leo Kinsulla	05 73	03	170	6	18				
Bay de Verde	42	Aiden Murphy & Rev. Walsh	09 67	03	152	6	52	82	20		
Bay de Verde	43	Clarence Norris	05 76	03	150 - 160		22				
Bay de Verde	44	R.J. Noah & Sons	07 66	03	150	6	43	70	11		
Bay de Verde	45	Rueban Emberley	10 67	03	125	6	16				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Bay de Verde	46	Quinlan Bros	12 64	03	107	6	36				
Bay de Verde	47	Rev. Walsh (parish)	04 67	03	84	6	28		15		
Bay de Verde	48	D.M.A.H.	11 65	03	175	8	46	75	10		
Bay de Verde	49	Allan Coish & Wm. Prior	04 70	03	340	6	13				
Bay de Verde	50	Quinlan Bros	09 67	03	92	6	21.5		4		
Bay de Verde	51	R.J. Noah & Assoc.	02 67	03	230	6	16	110	10		
Bay de Verde	52	Bert Coish	10 68	03	76	6	23	5	6		
Bay de Verde	53	R.C. School	01 68	03	102		39	12	20		
Bay de Verde	54	Tom Riggs	04 76	03	110		28				
Bay de Verde	55	Cyril Riggs	04 76	03	95		43				
Bay de Verde	56	Ross Blundon Wm. Barter Ray Noonan Morris Noonan	03 74	03	215						
Bay de Verde	57	Rev. Shea	01 65	03	27	6	27				
Bay de Verde	58	Ben Noonan	11 76	03	93		26				
Bay de Verde	59	Alden Noonan	11 76	03	186		25				
Bay de Verde	60	Heyward Keats	11 76	03	193		22	110	1		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Bay de Verde	61	Bacalieu Club	09 69	03	115		20		11		
Bay de Verde	62	Quinlan Bros	03 68	03	275	6	44		5		
Bay de Verde	63	Moses Wilfred & Wm. Riggs	11 76	03	300						
Bay de Verde	64	Quinlan Bros	11 67	03	71	6 4	60 62	32	10		
Bay de Verde	65	Quinlan Bros	04 68	03	268	6	14	150	4		
Bay de Verde	66	Edwin Noonan	08 76	03	89		22				
Bay de Verde	67	Wayne Quinlan	09 75	03	145	6	33	27	3.5		
Bay de Verde	68	D. Quinlan	07 75	03	97	6	32				
Bay de Verde	69	Stephen Eady	08 64	03	75		13	37	2		
Bay de Verde	70	C. Barter	08 64	03	80		22	36	2.5		
Bay Roberts	71	Morgan Bros Birch Hills Motel Ltd.	63		180	8			10		0-40 overburden 40-180 bedrock
Bay Roberts	72	Gideon Stockwood	01 70	03							
Bay Roberts	73	Eric Stevens	11 73	05	120	6	58				
Bay Roberts	74	Fish Plant	03 71	05	170	8 6	15 22				
Bay Roberts	75	C. Pilgrim	11 75	04	176	6	16				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Bay Roberts	76	Albert Spencer		05	90		21				
Bay Roberts	77	Albert French	12 71	03	90	6	40				
Bay Roberts	78	Jim Randell	12 72	03	75		35				
Bay Roberts	79	C. Greenland	08 71	03	75	6	32	8	1		
Bay Roberts	80	Nfld. Light & Power	01 72	03	100		48				
Bay Roberts	81	Lewis Dawe	01 70	09	100		54				
Bay Roberts	82	M. Ralph	05 74	09	99		26				
Bay Roberts	83	Wallace Cane	10 65	09	70						
Bay Roberts	84	Church of the Nazarene	04 70	09	131		40				
Bay Roberts	85	Mr. Russell	05 74	09	94		28				
Bay Roberts	86	New Lab Pre-Engineered Structures	12 68	03	96	6	51	0	5		
Bay Roberts	87	Yetman Bros	01 66	09	96						
Bay Roberts	88	Aubrey Smith	11 73	05	155		32		4.5		
Bay Roberts	89	D. Mercer	04 77	04	230	6	38				
Bay Roberts	90	LLoyd Lust	03 77	04	124	6	16				
Bay Roberts	91	E. A. Lang	07 62	05	130	6	28		3		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Bay Roberts	92	Moran's Hotel	05 63	05	176	6	13		5		
Bay Roberts	93	Anglican Church	07 62	05	115	6	27				
Bay Roberts	94	A. Noseworthy		05	88	6	23		10		
Bay Roberts	95	J. French	08 71	03	57		22	3	1		
Bay Roberts	96	New Lab Pre-Engineered Structures	12 68	03	66	4	61	6	1.5		
Bay Roberts	97	U.C. Parsonage	10 69	03	144	6	44		5		
Bay Roberts	98	J. F. Dawson	07 75	03	51	6 8	49 26				
Bay Roberts	99	A. Russell	64	03	60		19.5				
Bay Roberts	100	A. Spencer & Company	12 71	03	186		43		2		
Bay Roberts	101	Doug Walsh	10 71	03	71		20.5	23	1.5		
Bay Roberts	102	Town Council	05 74	05	220		12		4		
Bay Roberts	103	Fish Plant & Powells Supermarket	05 74	05	350		8		1		
Bay Roberts	104	J. Littlejohn	10 68	03	84		44		1.5		
Bay Roberts	105	Brookfield Ice Cream	03 62	05	175		25				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Bay Roberts	106	Town Council	04 71	05	210		17		8.5		
Bay Roberts	107	Walt Garland	06 74	04	127	6	24				
Bay Roberts	108	Hugh Atkinson	07 78	01	126		13		1.5	DO	0-8 overburden 8-126 shale
Bellevue	109	Bellevue Beach Club	01 73	05	52		52				
Bellevue	110	J. Robinson	07 79		590	6					
Bellevue	111	J. Robinson	03 79		110	6					
Bishops Cove	112	D.M.A.H.	11 75	04	285	6		29	1		
Black Head	113	F. Hollett	07 73	03	90	6	43		1.5		
Black Head	114	Mr. Peach	02 72	03	95		45	25	3.5		
Black Head	115	Jack Moores	10 71	03	64	6	19	8	5		
Black Head	116	W. Hollett	09 73	03	145		50	25	1		
Black Head	117	J. Clarke	06 73	03	118	6	25		1.5		
Black Head	118	H. Moore	10 73	03	80	6	30	15	3		
Blow me Down	119	D.M.A.H.	09 74	05	310		11	11	3		
Brigus	120	Rev. R. Wells U.C. Manse	65		90	4			2		
Brigus	121	Wm. Higgins	04 76	01	200	6			1	DO	0-21.5 overburden 21.5-200 bedrock

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Brigus	122	Gulf Oil Canada Ltd.	06 69	03	125	6	57		1.33		
Brigus	123	Robert Percy	05 76	05	125		15		.5		
Brigus	124	Dept. Public Works	07 73	05	225		18				
Brigus	125	Town Council	04 73	05	150		10		1		
Brigus	126	Town Council	04 73	05	300		8				
Brigus	127	Town Council	04 73	05	250		8		2		
Brigus	128	St. Patricks Parson	65		123	6			8		
Brigus	129		04 76	05	210		14		.5		
Brigus	130	Pendergast's Hotel	06 72	05	310		16				
Brigus	131	Pendergast's Hotel	06 72	05	90		23				
Brigus	132		04 76	05	180				1.5		
Brigus	133	J. Furey Ltd.	10 72	03	307	6	20		3		
Brigus	134	J.W. Hiscock & Sons Ltd.	01 72	05	48		12				
Brigus	135	Brigus School Board	02 69	03	177	6	21		12		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Brigus	136	Dave Hiscock	05 69	03	69	6	20				
Brigus	137	G. Pomeroy	06 65	03	98		21				
Brigus	138	C. Spracklin	05 70	03	119		22				
Brigus	139	G. Rose	08 77	04	77	6	15				
Brigus	140	Frank Wilcox	06 72	05	110	6	27				
Brigus	141	Terry O'Brady	06 77	04	135	6	17				
Brigus	142	Ernest Gushue	06 77	01		6	32		0.5	DO	0-26 overburden 26-94+ sandstone
Brigus	143	Phyllis Percy	05 76		99		15				
Bristols Hope	144	Edward Chafe	06 75	03	92		29	20	6		
Bristols Hope	145	John Peddle	04 74	03	92		35		4		
Bristols Hope	146	Tom Dunne	05 77	04	115	6	16				
Bristols Hope	147	Paul Forward	11 74	04	80	6	34				
Bristols Hope	148	Freeman Yetman	10 76	04	34	6	10				
Bristols Hope	149	Stan Parsons	09 75	03	100		43				
Broad Cove	150	D.M.A.H.	08 74		341	6	12	0	1.2		
Broad Cove	151	Quinlan Bros	03 69	03	113	6	48	35	4.5		
Broad Cove	152	C. Burden	05 69	03	88	6	28	16			

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Broad Cove	153	Nfld Tel. Co.	11 75	03	88	6	30		2		
Broad Cove	154	C. Delaney	06 75	03	108		23		4		
Broad Cove	155	Harold LeGrow	12 69	03	60		18				
Broad Cove	156	Mr. Slade	11 68	03	215	6	49				
Brownsdale	157	W.F. Brown	06 67	03		6					
Brownsdale	158	Chelsey Head	09 74	03	56		17		1		
Brownsdale	159	Mr. Wheeler	05 67	03	65	6	28				
Brownsdale	160	Allen Thorne	10 65	03	55		34		6		
Brownsdale	161	Brownsdale School	03 67	03	34		26				
Brownsdale	162	High School	03 68	03	145	6	23	6	10		
Brownsdale	163	Mr. Button	04 67	03	68		26				
Brownsdale	164	James Pike	03 75	03	77		10				
Bryants Cove	165	D.M.A.H.	05 73	05	198	6	36	1	4		
Bryants Cove	166		62		90	6		30	5		0-35 overburden 35-90 bedrock
Bryants Cove	167	Community	06 79		310	6		30	6		
Burnt Point	168	F.J. Nolan & Assoc. Ltd.	12 71	03	220	6	32		2		
Burnt Point	169	D.M.A.H. M. Milley	12 74	05	205		21		15		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Burnt Point	170	D.M.A.H. Clayton Wicks	05 75	01	180	6	24		6		
Burnt Point	171	D.M.A.H. John Tucker	11 74	03	95		36		4		
Burnt Point	172	D.M.A.H.	07 76		218				1		
Burnt Point	173	Jessie Oliver	07 75	03	70		22				
Burnt Point	174	Quinlan Bros	02 68	03	134	6	22		8		
Burnt Point	175	Pat Oliver		03	74		50				
Burnt Point	176	Heyward and Lloyd Wicks	09 67	03	211	6	30	52			
Butter Cove	177	R. Spurrell	08 78	01	80	6	7		0.25	DO	0-80 siltstone
Butter Cove	178	R. Spurrell	08 78	01	45	6	7		0.75	DO	0-45 siltstone
Butter Cove	179	R. Spurrell	08 78	01	65	6	11		0.75	DO	0-2 2-65 siltstone
Butter Cove	180	R. Spurrell	11 77	01	65	6	14		0.50	DO	0-2 gravel and broken rock 2-65 sandstone
Caplin Cove	181	D.M.A.H. C. Bursey	05 75	01	220	6	22		25		0-22 overburden 22-220 bedrock
Caplin Cove	182	Arthur Champion	07 64	03	80	6	26				
Caplin Cove	183	Wallace Cull	12 72	03	94	6	17		2		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Carbonear	184	Nfld Tel. Co.	11 75	03	100		32		3		
Carbonear	185	Nelson Ford	10 76	04	270	6	10				
Carbonear	186	Wm. Sutton	05 68	09	84						
Carbonear	187	Saunders and Howell	12 64	03	98	6	39				
Carbonear	188	Bill Horwood	08 73	03	80	6	46				
Carbonear	189	Anchor Lounge	12 76	03	115	6	40		5		
Carbonear	190	Felix McCarthy	01 76	03	125		35	10	3		
Carbonear	191	Saunders and Howell	06 74	03	166		44				
Carbonear	192	Ayre's Ltd.			110	6					
Carbonear	193	W. Baker	09 78	01	190	6	6		4	DO	0-50 sand and boulders 50-190 sandstone
Carbonear	194	B. Rose	04 78	01	115	6	19		3	DO	0-12 gravel 12-115 shale
Cavendish	195	D.M.A.H.	09 71	03	142	6	18	0	2		0-18 overburden 18-142 bedrock
Cavendish	196	D.M.A.H. N. Jackson	08 75	03	138	6	30	18	6		
Cavendish	197	D.M.A.H. R. Critch	08 75	03	260	6	30	8	4		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Cavendish	198		03 69		200						0-20 overburden 20-200 bedrock
Cavendish	199	Walter Brown	01 76	03	135		50				
Cavendish	200	Albert Critch	09 74	03	71		12		2.5		
Chance Cove	201	Town Council	11 77	01	200	6	8		8	DO	0-3 gravel 3-200 sandstone
Chance Cove	202	Town Council	11 77	01	230	6	20	over-flowing	12	DO	0-16 sand and boulders 16-230 sandstone
Chance Cove	203	Fish Plant	06 78	01	300	6	21		1.5	IN	0-15 gravel 15-300 shale
Clarenville	204	Dept. High-ways	02 75	01	307	6			10	IN	0-83 overburden 83-307 bedrock
Clarenville	205	E.K. Jerrett & Assoc. Ltd.	75		300				7		
Clarenville	206	Clarenville Area Co-op	09 70	03	100	8 6	9 19				
Clarenville	207	Clarenville Lions Club	07 69	03	123	6	34	17	2		
Clarenville	208	Magistrates Residence & Welfare Officer Residence	12 72	05	133		20		2		
Clarenville	209	Salvation Army Board of Education	08 62	05	175	6	14		7		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Clarenville	210	Gerald Duffett	08 69	03	131		9	20	3		
Clarenville	211	Alfred Jones	07 72	03	163	6	15		1.5		
Clarenville	212	S. Duffett	09 61	05	230	6	10		4-5		
Clarenville	213	Irving Oil	10 74	05	235		15		2.5		
Clarenville	214	United Church Board of Education	07 63	05	205		15		6		
Clarenville	215	Bramwell Coish	08 69	03	70		20	5	3.5		
Clarenville	216	Texaco Service Station	09 68	05	35		6				
Clarenville	217	Texaco Service Station	09 68	05	299		10				
Clarenville	218	Nfld. Hardwoods	11 71	05	290		21		1		
Clarenville	219	Welfare Officer Residence	12 72	05	265		40		2		
Clarenville	220	Frank Tilley	10 73	05	270	6	11				
Clarenville	221	Mr. Hunt	07 79		70	6					
Clarenville	222	City Builders	06 79		320	6					
Clarenville	223	DOT&C	11 77	01	125	6	22		4	DO	

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Clarkes Beach	224	Pentecostal Benevolent Assn.	67		165	6		11	5		
Clarkes Beach	225	G. Wilson	07 73	05	110		31				
Clarkes Beach	226	Town Council	05 76	05	265		27		15		
Clarkes Beach	227	Town Council	04 71	05	200		43		30		
Clarkes Beach	228	G. Wilson & Sons	06 75	04	45	6	18				
Clarkes Beach	229	Town Council		05	230		78		10		
Clarkes Beach	230	Town Council	08 77	05	90		18		10		
Clarkes Beach	231		12 77	01	190	6	55		1.5	DO	0-50 sand and granite 50-190 shale
Clarkes Beach	232	Town Council	07 73	05	250		25				
Coleys Point	233	Stan Dawe	10 74	04	60	6	18				
Coleys Point	234	Roy Dawe	11 76	04	180	6	24				
Coleys Point	235	Alan Jackson	08 76	04	185	6	25				
Coleys Point	236	Bay Roberts Town Council	09 75	04	100	6	45				
Coleys Point	237	R. Thompson	08 75	04	82	6	25				
Coleys Point	238	B. Thompson	09 73	03	100	6	36	70	2		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Come by Chance	239	Public Works	12 73		203	6		20.5	6		
Crocker Cove	240	D.M.A.H.	06 70	05	125		20		7		
Cupids	241	Lawes Coffee Shop	09 76	05	240		26		1		
Cupids	242	H.B. Dawe Ltd	01 72	05	50		12				
Cupids	243	W. Spracklynn	08 68	03	132	6	36	20	1.25		
Cupids	244	H. Clarke	10 75	04	65	6	25				
Cupids	245	H. Bishop	10 75	04	55	6	15				
Cupids	246	R. Ackerman	09 76	04	80	6	20				
Cupids	247	H. Somerton	07 76	04	180	6	17				
Cupids	248	Eric Stone	07 76	04	150	6	18				
Cupids	249	Bay Roberts Enterprises	05 76	04	94	6	20				
Cupids	250	Lawes Restaurant	04 74	05	355						
Cupids	251	James Collins	08 77	04	105	6	23				
Deep Bight	252	B.T.B. School Board	07 80	01	170	6	29		2	MU	0-26 sand and boulders 26-170 granite and sandstone
Deep Bight	253	G. Chalock	07 80	01	150	6	7		0.5	DO	0-2 gravel 2-150 sandstone

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Deep Bight	254	Graham Smith	07 80	01	200	6	23		0.5	DO	0-20 boulders 20-200 sandstone
Deep Bight	255	Alex Vardy	05 79	01	105	6	7		0.5	DO	0-5 gravel and broken rock 5-105 sandstone
Deep Bight	256	Roy Forward	06 78	01	140	6	24		1	DO	0-16 gravel 16-140 shale
Dildo	257	D.M.A.H.	05 74		177	6		10.6	17		
Dildo	258	D.M.A.H.	03 78		263	6		3.5	40		
Dildo South	259								7		
Dildo South	260	D.M.A.H.	05 73		233	6		7.5	4		
Dildo South	261	D.M.A.H.	09 74		363	6		20.5	1.5		
Elliotts Cove	262	Melvin Patev	03 74	09	200		40				
Freshwater	263	D.M.A.H.	03 73	03	85	6	22	10	12		
Freshwater	264	D.M.A.H.	01 74	03	154	6		15.2	1.5		
Freshwater	265	D.M.A.H.	01 74	03	87	6		12.5	3.5		
Freshwater	266	D.M.A.H.	03 73	03	165	6	40	18	6		
Freshwater	267	W. Marshall	07 76	03	91		22				
Freshwater	268	Frank Parsons	01 76	03	74		28				
Freshwater	269	C. Marshall	02 76	03	84		22				
Freshwater	270	S. A. Parsons	08 77	04	90	6	11				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date mo/yr	Driller	Depth ft	Casing Dia. in	Casing Lgth. ft	Static Water Level ft	Yield gpm	Water Use	Lithology
Freshwater	271	Calvin Howell	09 79		150	6					
Freshwater	272	John Parsons	09 78	01	65	6	12		10	DO	0-5 gravel 5-65 sandstone
Gooseberry Cove	273	Ernest Seward	12 79	01	65	6	10		1.5	DO	0-2 gravel 2-65 granite
Gooseberry Cove	274		06 78	01	160	6	7		0.5	DO	0-160 siltstone and granite
Grates Cove	275	D.M.A.H. S. Anthony	05 75	01	200	6			15	MU	0-13.5 overburden 13.5-200 bedrock
Grates Cove	276	D.M.A.H. D. Vey	05 75	01	282	6	22	10	7	MU	0-22 overburden 22-282 bedrock
Grates Cove	277	D.M.A.H.	04 75	01	220	6			10	MU	0-28 overburden 28-220 bedrock
Grates Cove	278	D.M.A.H. Mr. Lambert		05	380		12		6		
Grates Cove	279	D.M.A.H. Mr. Cooper		05	300		13		2		
Grates Cove	280	D.M.A.H. G. Doyle	05 75	01	220	6	35		10	MU	0-35 overburden 35-220 bedrock
Grates Cove	281	Dept. of Fisheries	08 71	03	211		44	10	2		
Grates Cove	282	Quinlan Bros	08 66	03	199	6	32				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Green's Harbour	283	Comm. & Soc. Development	09 71	05	151	6	28	21.1	1.3		
Green's Harbour	284	D.M.A.H.	71	05	152	6	28	12	4		
Green's Harbour	285	D.M.A.H.		05	124	6	29	0	9.5		
Green's Harbour	286	D.M.A.H.	09 71	05	146	6	30	3.5	3.5		
Green's Harbour	287	D.M.A.H. S. Hefford	10 71	05	92	6	20	0	12	DO	
Green's Harbour	288	D.M.A.H. D. Loader O. Cooper	09 74	05	300		26	42	4		
Green's Harbour	289	D.M.A.H. L. Brace	10 75	03	183		27	14	>20		
Green's Harbour	290	D.M.A.H. Reid, Simmons	09 74	05	120		47	22	20-30		
Green's Harbour	291	D.M.A.H. J. Green			150				2-3		
Green's Harbour	292	H.E. Crooker	07 73	03	104		30	40	3		
Green's Harbour	293	D.M.A.H.	71		130	6			1		
Green's Harbour	294	Doctor's Residence	08 68	03							
Green's Harbour	295	Llewellyn Reid	06 63	03	38		20				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Green's Harbour	296	D.M.A.H.	11 67	03	126		32				
Green's Harbour	297	H. Crocker	02 71	03	80	6	16		10		
Green's Harbour	298	Roy Perry	08 74	03	133		32	60	2.5		
Green's Harbour	299	D.M.A.H.	06 68	03	125	6	33	18	9		
Gull Island	300	D.M.A.H.	05 75	01	116	6	10.5	25	10	MU	0-10.5 overburden 10.5-116 bedrock
Gull Island	301	A. Delaney	12 74	05	175		63	36	12		
Gull Island	302	D.M.A.H.	05 75	01	220	6	14.5	6	7	MU	0-14.5 overburden 14.5-220 bedrock
Gull Island	303	Comm. & Soc. Development	03 71	03	200	6	40	24	4		
Gull Island	304	J. Stockwood		03				0	40		
Gull Island	305	D.M.A.H.	11 75	03	165	6	44	10	6		
Gull Island	306	E. & G. Oliver	09 73	03	97		77				
Gull Island	307	S. Doyle	08 71	03	86	6	22				
Gull Island	308	L. Johnson	07 73	03	90	6	21		2		
Gull Island	309	J. Doyle	09 76	05	130		15		2.5		
Gull Island	310	J. Doyle	10 75	05			19		1.5		
Gull Island	311	P. Oliver	10 75	05	55		18		3		
Gull Island	312	E. Oliver	77	05	70		14				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Gull Island	313	M. Johnson	09 76	05	70		36		20		
Gull Island	314	L. Mulkaley	09 76	05	50		30		6		
Gull Island	315	E. Delaney	09 76	05	50		10		10		
Gull Island	316	J. Layman	08 77	05	175		33				
Gull Island	317	P. Doyle	11 76		80		22		4		
Gull Island	318	Mrs. Will John Delaney	05 72	03	80		30				
Gull Island	319	J. Badstock	06 77	05	80		18		4		
Gull Island	320	G. Stockwood	07 69	03	80		38				
Gull Island	321	J. Stockwood	06 70	03	66	6 8	22 11				
Gull Island	322	Peter Hogan	06 74	03	88		22		3		
Halls Town	323	D.M.A.H.	04 75		190	6	85	45	9		
Hants Harbour	324	High School			65				6		
Hants Harbour	325	Fish Plant						0	10-15		
Hants Harbour	326	Public Works	04 69	05	200	6	39	10.5	6.5		0-29 overburden 29-200 bedrock
Hants Harbour	327	P. Janes &Son	05 68	03	175	6	22	0	8		
Hants Harbour	328	R. Ellis	06 67	03	82		14				
Hants Harbour	329	P. Janes &Son	08 65	03	150		13.5				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Hants Harbour	330	School	01 65	03	60	6	14				
Hants Harbour	331	E. Morgan	11 69	03	70	6	20				
Harbour Grace	332	D.M.A.H.	09 71		250	6	40	7.9	1		
Harbour Grace	333	Babb Const.	07 73	05							
Harbour Grace	334	Golden Eagle	70	09	143						
Harbour Grace	335	North East Fish Ind.	12 62	05	146	6	3		2		
Harbour Grace	336	North East Fish Ind.	11 61	05	145	6	10				
Harbour Grace	337	North East Fish Ind.	01 63	05	326	6	15		4		
Harbour Grace	338	Golden Eagle	12 70	09	113						
Harbour Grace	339	Heber Babb	08 68	09	114						
Harbour Grace	340	Town	08 66	09	132						
Harbour Grace	341	Ward Pike	11 65	09	80						
Harbour Grace	342	Ben Farrell	07 68	09	89						
Harbour Grace	343	Burt Morgan	07 77	04	90	6	24				
Harbour Grace	344	Pat Hickey	06 70	09	120		33				
Harbour Grace	345	G. Byrne	06 69	09	119		35				
Harbour Grace	346	B. Foley & L. McNamara	10 65	09							

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Hopeall	363	D.M.A.H. G. Cumby	09 74	05	150		25	31	20		
Hopeall	364	D.M.A.H.	03 72	03	120	6	35				
Hopeall	365	D.M.A.H.	63		185		40				
Hopeall	366	D.M.A.H.	06 75	05	115		32				
Hopeall	367	Fish Farm		05	130	6	36		2		
Islington	368	O. Roberts	09 75	03	100	6	44		4		
Islington	369	Nfld. & Lab. Housing Corp.	01 75	03	109	6	28		4		
Islington	370	Jake Chislett	09 74	03	62		22				
Jobs Cove	371	Mrs. Button	05 72	03	90	6	18		3		
Jobs Cove	372	J. English	05 72	03	90	6	21		3		
Jobs Cove	373	Joe Johnson	11 74	03	64		22				
Jobs Cove	374	R. Johnson	12 74	03	147		22		1		
Jobs Cove	375	Pius Colbert	11 75	03	100		22				
Jobs Cove	376	H.G. Crocker	01 74	03	85		20		3		
Jobs Cove	377	Boyd Button	12 66	03	80		20	16	2		
Jobs Cove	378	D. Johnson	06 74	03	90		29				
Little Harbour	379	D.M.A.H.	04 73		37	6	27	9.4	8		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date mo/yr	Driller	Depth ft	Casing Dia. in	Casing Lgth. ft	Static Water Level ft	Yield gpm	Water Use	Lithology
Little Harbour	380	D.M.A.H.	04 73		220	6	11	141	0.5		
Little Harbour	381	D.M.A.H.				6			8.5		
Little Harbour	382	D.M.A.H.	12 72	05	204.5	6	11	9.5	1.5		
Little Harbour	383	Community	12 72	05	40		27				
Little Harbour	384	Community	12 72	05	150		10				
Little Harbour	385	Nfld Gov't.	06 75	05	200		11				
Little Hearts Ease	386	Spurrell	08 78	01	95	6	22		0.75	DO	0-18 gravel 18-95 shale
Long Beach	387	D.M.A.H.	05 75	01	200		22	14	15	MU	0-22 overburden 22-200 bedrock
Low Point	388	D.M.A.H.	01 74	03	115.2	6	30	9	1.5		
Low Point	389	D.M.A.H. James Power									
Lower Island Cove	390	D.M.A.H.	09 71	03	114.5	6	16	15.5	4.5		
Lower Island Cove	391	D.M.A.H.	05 75	01	240	6	13	9	6	MU	0-13 overburden 13-240 bedrock
Lower Island Cove	392	D.M.A.H.	09 73	03	128	6	25	22	20		
Lower Island Cove	393	C. Bursey D.M.A.H.	06 71		172	6		11	1.75		
Lower Island Cove	394	Comm. & Soc. Development	10 71	03	172	6	22		4		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date mo/yr	Driller	Depth ft	Casing Dia. in	Casing Lgth. ft	Static Water Level ft	Yield gpm	Water Use	Lithology
Lower Island Cove	395	Myers Eng.	05 73	03	245	6	23	14	30		
Lower Island Cove	396	F. Bursey	10 67	03	48		22	20	20		
Lower Island Cove	397	P. Sparks Sr	04 68	03	90		20				
Lower Island Cove	398	T. Garland	09 76	03	98		22		4		
Lower Island Cove	399	Wm. Leshane	09 64	03	75		20	19	0.5		
Lower Island Cove	400	Canning & Butler	05 65	03	75		27	8	6		
Lower Island Cove	401	Myers Eng.	08 73	03	277	6	27	15	22		
Lower Island Cove	402	Allan Norris	09 66	03	96	6	37		1.5		
Lower Island Cove	403	H. Bursey	06 74	03	163		84		0.5		
Makinsons	404	Community			167	6		14.6	2		
Makinsons	405	D.M.A.H.	01 73	05	200		18		2		
New Chelsea	406	Nolan, White & Assoc. Ltd.	02 72	03	103	6	22	6	12		
New Chelsea	407	Nfld. Tel.	09 76	03	115		18	13	1		
New Chelsea	408	H. Trimm	05 65	03	60		29		8		
New Chelsea	409	E. Squires	08 74	03	93		22				
New Chelsea	410	C. Pynn	02 65	03	55	6	13		3		
New Chelsea	411	S. Harris	11 68	03	80		31				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
New Chelsea	412	Robert Trimm	05 75	03	73		23				
New Chelsea	413	M. Harris	09 76	03	77		30		3		
New Chelsea	414	Wm. Mansfield	05 65	03	37		12	9	2		
New Chelsea	415	W. Belbin	05 65	03	46	6	13	5	1.5		
New Chelsea	416	Clarence Pynn	05 71	03		4	51				
New Harbour	417	D.M.A.H. Gerald Goosney	02 76	05	Deep-ened 175 - 265		11	36	15		
New Harbour	418	D.M.A.H. Lewis Marsh	10 75	03	200	6	70		6		
New Harbour	419	D.M.A.H.			165		6	8	1.5		
New Harbour	420	D.M.A.H.	10 71	05	183	6	47		1.5		
New Harbour	421	D.M.A.H.	10 71	05	182		11				
New Harbour	422	C. Woodman									
New Harbour	423				184			7			condemned
New Harbour	424	C. Davis	10 69	05	110		15			DO	poor quality
New Harbour	425	Avalon North Int. School Board	10 69	05	110		16				
New Harbour	426		11 76		110		36		2		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
New Harbour	427	D.M.A.H.	07 75	05	175		11		7.5		
New Harbour	428	Mr. Higdon	04 74	09	95		21				
New Harbour	429	Ron Higdon	02 73	03	152		22	9	9		
New Harbour	430	Comm. & Soc. Development	10 71	05	182		11				
New Harbour	431	Avalon North Int. School Board	11 70	03	120	6	22		5		
New Harbour	432	Nfld. Tel.	06 71	03	86		22	12	5		
New Harbour	433	D.M.A.H. Lewis March	10 75	03	200	6	70		6		
New Harbour	434	F. Pitcher	10 78		150	6					
New Harbour	435	Dave Ganon	11 78	01	310	6	30.5		1.5	DO	0-25 gravel 25-310 siltstone
New Harbour	436	Ron Higdon	05 78	01	350	6	23		1.5	DO	0-11 gravel 11-350 siltstone
New Melbourne	437	S. Driscoll	08 75	03	78						
New Melbourne	438	C. Button	09 67	03	83		36				
New Perlican	439	G. Mills	12 67	03	74		20				
New Perlican	440	Perwin School Board	12 67	03	148	6	16	18	6.5		
Normans Cove	441	D.M.A.H.			230				4		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Normans Cove	442	Town	01 73	05	400	6	18				
Normans Cove	443	Town	01 73	05	200	6	12				
Normans Cove	444	Jacob & Rex Newhook	08 76	05	260		13		2		
Normans Cove	445	Nath Smith	10 73	03	257	6	28	15	6		
Normans Cove	446	Avalon North Int. School Board	02 73	05	60	6	7		11		
Normans Cove	447	L. Barrett	02 76	03	127	6	21				
Normans Cove	448	Nfld. Tel.	10 72	03	130	6	20	10	2		
Normans Cove	449	Town Council	09 79		70	6					
Normans Cove	450	Town Council	09 79		400	6					
Normans Cove	451	Town Council			155	6					
Normans Cove	452	Rural District Council	11 77	01	200	6	13		12	DO	0-9 gravel 9-200 sandstone
Normans Cove	453	Rural District Council	11 77	01	230	6	11		15	DO	0-8 gravel 8-230 granite and sandstone
North River	454	D.M.A.H.	04 75	04	190	6	85				
North River	455	R.C. Convent	03 70	03	190	6	82	12	15		
North River	456			05	100		100				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
			mo/yr		ft	Dia. in	Lgth. ft	ft	gpm		
North River	457	Community Council	10 75		325		32		5.5		
North River	458			05	150		10				
North West Brook	459	Eli Dean	10 75	01	78	6			1.5		0-14.5 overburden 14.5-78 bedrock
North West Brook	460	George Soper	02 80		140		29		2		
Northern Bay	461	D.M.A.H.		03	164	6	42	19	6.5		
Northern Bay	462	D.M.A.H.	03 73	05	160		20		1.5		
Northern Bay	463	Leo Hogan D.M.A.H.	08 75	03	194	6	42	17	10		
Northern Bay	464	Bren Howard	07 74	03	100		30				
Northern Bay	465	Comm. & Soc.	03 70	03	268	6	53				
Northern Bay	466	C & M Doyle	02 72	03	110		22		3.5		
Northern Bay	467	Mr. O'Flarety	11 76	03	95	6	39				
Northern Bay	468	Seaside Sands Ltd.	07 69	03	63		38				
Ochre Pit Cove	469	D.M.A.H.	12 76	01	45	6			2		0-11 overburden 11-45 bedrock
Ochre Pit Cove	470	D.M.A.H.	09 74	03	88	6	88		9		
Ochre Pit Cove	471	John Halfyard	07 77	05	80		18				

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Ochre Pit Cove	472	N. Gillingham	77	05	175		18				
Old Perlican	473	Roy Howell	06 74	05	80		30		4.5		
Old Perlican	474	H. Butt	06 74	05	70		29		4.5		
Old Perlican	475	Byron Button	10 72	03	109		22				
Old Perlican	476	W. Button	11 75	03	71	6	31				
Old Perlican	477	Jack Barrett	04 65	03	44	6	17	3	5		
Old Perlican	478	Golden Eagle Refining Co.	04 68	03	118	6	22				
Old Perlican	479	James Cooper	07 76	03	125		28	25	1		
Old Perlican	480	Comm. & Soc. Development	03 70	03	200	6	28				
Old Perlican	481	Stan Jolliffe	08 72	03	102		24	0			
Old Perlican	482	Allan Adams	10 73	03	98	6	17	8	4		
Old Perlican	483	Arthur Howell	08 72	03	74		34		2		
Old Perlican	484	H. Cooper per Bank Nova Scotia	08 79	01	105	6	20		1	DO	0-18 gravel 18-105 sandstone
Old Perlican	485	Jim Hopkins	11 77	01	146	6	35		2.75	DO	0-30 gravel 30-146 shale
Old Shop	486	P. Godsland	12 75	05	70		26		3-4		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Perry's Cove	487				203			13			
Perry's Cove	488	Comm. & Soc. Development	08 71	05	150		24		2		
Perry's Cove	489	Wm. Swain	08 67	03	72	6	21				
Perry's Cove	490	Quinlan Bros	09 67	03	76	6	20	3	4		
Petley	491	D.M.A.H.	08 75	01	200	6	21.5		50	MU	
Port de Grave	492	D.M.A.H.	08 75	04	200	6	35		20		
Port de Grave	493	Marine Centre	12 72	03	145	6	30	5	5.5		
Port de Grave	494	B. Morgan	07 77	04	150	6	14				
Port de Grave	495	C. Petten	08 77	04	140	6	10				
Port de Grave	496	Jack Blair	06 76	04	139	6	10				
Port de Grave	497	Bill Andrews	08 76	04	80	6	9				
Port de Grave	498	Mr. Porter	07 74	09	365						
Port de Grave	499	D.M.A.H.	08 75	04	200	6	20				
Port de Grave	500	S. Christopher	08 72	03	103	6	39		0.5		
Port de Grave	501	Wm. Petten	03 78	01	106	5	10.5	11	2.5	DO	0-4 gravel 4-106 siltstone
Port de Grave	502	Ocean Harvesters	03 78	01	162	6	22	5	15-20	IN	0-11 gravel 11-162 siltstone and limestone

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Port de Grave	503	Ocean Harvesters	02 78	01	450	6	31		3	IN	0-22 gravel 22-450 bedrock
Port de Grave	504	Ocean Harvesters	02 78	01	350	6	22	11	3	IN	0-14 gravel 14-350 siltstone
Red Head Cove	505	Joseph Hyde	10 75	03	90		31				
Red Head Cove	506	P. Quinlan	02 69	03	85	6	45		5		
Red Head Cove	507	Jack Kehoe		03	75		15		1.5		
Red Head Cove	508	School	11 70	03	113	6	26	12	6		
Red Head Cove	509	Dennis Hatch	03 66	03	63		16				
Riverhead	510	Joe Mercer	10 75	05	160		28	11	10		
Riverhead	511	T. Cleary D.M.A.H.	10 75	05	175		15	27	12		
Riverhead	512	Wm. Dawe	06 74	09	90		30				
Riverhead	513	Wm. Hearn	05 74	09	84		37				
Riverhead	514	John Delaney	11 76	04	50	6	20				
Riverhead	515	Nfld. Light & Power			150	6					
Roaches Line	516		1 64	02	60						0-15 boulders and gravel 15-60 bedrock
Roaches Line	517		12 63	02	240						0-27 gravel and boulders 27-240 bedrock

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Roaches Line	518		10 63	02	150						0-16 overburden 16-150 bedrock
Roaches Line	519	Smallwood Pullet Ltd.			355	4	50		9	IN	
Roaches Line	520	F. Cranford	04 75		80	6	60				
Roaches Line	521		02 64	02	43						0-12 overburden 12-43 bedrock
St. Jones Within	522	Bonavista Trinity Placentia School Board	06 75	08	78	6	11		0.75		
Salmon Cove	523	S. Slade	06 67	03	78	6	14	9			
Salmon Cove	524	Eric Slade	08 75	03	80		19		5		
Salmon Cove	525	John Vaters	07 70	03	77		15		2.5		
Salmon Cove	526	R. Case	02 66	03	73		24				
Salmon Cove	527	A. Kelloway	05 68	09	100						
Salmon Cove	528	Martin White	10 73	03	95	6	18		2		
Salmon Cove	529	Lloyd Case	08 75	03	95		32	16	4		
Salmon Cove	530	D.M.A.H.	10 75		199	6			7		
Salmon Cove	531	D.M.A.H.	10 75		205.5	6			10		
Salmon Cove	532	Comm. & Soc. Development	09 71		165	6		8	4		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Salmon Cove	533	D.M.A.H.	10 75		166	6			7		
Salmon Cove	534	D.M.A.H.	03 73		185	6	12	2.6	0.7		
Salmon Cove	535	H. Pottle	06 75	03	118		28				
Salmon Cove	536	D.M.A.H.	10 75		218.5	6			5		
Salmon Cove	537	J. Slade	11 76	01	116	6			3	DO	0-16 overburden 16-116 bedrock
Salmon Cove	538	Comm. & Soc. Development	08 71	09	77	6	28		8		
Salmon Cove	539	D.M.A.H.	10 75		206.5	6			6		
Salmon Cove	540	Nolan, White & Assoc. Ltd.	08 75	05	64	8	43		100		
Salmon Cove	541	Community			79		36	14.25	30		
Salmon Cove	542	D.M.A.H.	10 75		65	8			50		
Salmon Cove	543	Twon Council	10 75	03	205		25				
Salmon Cove	544	George Case	66		75	8		32	6	DO	
Salmon Cove	545	H. Kelloway	05 68	09	75						
Salmon Cove	546	Comm. & Soc. Development	08 71	05	79		36		30		
Salmon Cove	547	Comm. & Soc. Development	08 71	05	182		13		3		
Salmon Cove	548	H. Parsons	09 65	09	71				2.5		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Salmon Cove	549	Salmon Cove Council	12 75	03	212	6	40				
Salmon Cove	550	Town Council	11 75	03	224		34	14			
Salmon Cove	551	Town Council	10 75	03	152	6	38				
Salmon Cove	552	D.M.A.H.	10 75		152	6			6		
Salmon Cove	553	Town Council	11 75	03	211	6	11				
Salmon Cove	554	R. Wareham	06 69	03	90	6	19.5				
Salmon Cove	555	Nelson Coish	08 73	03	85		42		5		
Salmon Cove	556	John Parsons	05 75	03	125		22				
Salmon Cove	557	Avalon North Integrated School Board	02 72	03	106		28	2	3.5		
Salmon Cove	558	Dept. Rural Development	03 73	03	187		22		6		
Salmon Cove	559	Dept. Rural Development	03 73	03	170	6	26		8		
Salmon Cove	560	Town Council	10 75	03	169		22				
Salmon Cove	561	D.M.A.H.	03 73		169	6		18.1	4		
Salmon Cove	562	George Chaulk	07 74	04	138	6	26				
Salmon Cove	563	Jim Reynolds	05 78	01	126	6	25		2	DO	0-16 gravel 16-126 shale

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Salmon Cove	564	Harris Penny	10 77	01	250	6	20		0.25	DO	0-11 gravel 11-250 shale
Shearstown	565	Avalon North Integrated School Board	11 70	03	193	6	50	18	15		
Shoal Harbour	566	F. Salters	05 75		190	6	26	19	0.25	DO	
Shoal Harbour	567	Clarenville Integrated School Board	10 74		80		12	7	6	MU	
Shoal Harbour	568	D.M.A.H.	75		97	6	54.5	23	65		
Shoal Harbour	569	B. Haines	10 74		146		30				
Shoal Harbour	570	Bill Hookey	10 74	08	112		70				
Shoal Harbour	571	Town Council	07 75	01	75	6			15	MU	0-44 overburden 44-75 bedrock
Shoal Harbour	572	Town Council	07 75	01	200	6			0.5	MU	0-22 overburden 22-200 bedrock
Shoal Harbour	573	Town Council	07 75	01	160	6			1.5	MU	0-43 overburden 43-160 bedrock
Shoal Harbour	574	Town nouncil	07 75	01	220	6			1	MU	0-42 overburden 42-220 bedrock
Shoal Harbour	575	Don Adams	08 75	01	230	6				DO	0-73 overburden 73-230 bedrock
Shoal Harbour	576	Roy Greening	10 72	03	137	6	28		6		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Shoal Harbour	577	Bren Power Limited	02 72	03	126		44				
Shoal Harbour	578	Vardy's Mobile Homes	05 74	03	224		22		1.5		
Sibley's Cove	579	Fish Plant	06 75	05	340		11		4		
Small Point	580	Cliff Howe	07 68	03	70		53				
South River	581	Nath Anthony	08 76	05	250		110		3		
South River	582	Doug Critch	10 75	05	62		42		15		
South River	583	Town Council	10 70	03	233	6	61	24	25		
South River	584	M. Hammond		05	210	6	105				
South River	585	G. Wilson & Sons Ltd.	05 76	04	60	6					
South River	586	D.M.A.H.	01 76	05	345		98		2		
South River	587	Town	02 73	05	325	6			2		
South River	588	Rev. Ludlow	06 78	01	105	6	44		1.25	DO	0-38 gravel and boulders 38-105 sandstone
Southern Harbour	589	Town Council	01 71	03	158	6	22.5	8	5		
Southern Harbour	590	Town Council	10 70	03	225	6	32.5		2		
Southport	591	Dean	08 78	01	106	6	10.5		1	DO	0-3 gravel 3-106 siltstone

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Southport	592	Kelley	08 78	01	126	6	12		0.75	DO	0-4 gravel 0-126 siltstone
Spaniards Bay	593	D.M.A.H.	10 75	05	200		15		7		
Spaniards Bay	594	D.M.A.H.	09 74	05	470		58	30	2		
Spaniards Bay	595	D.M.A.H.	08 74	04	45						
Spaniards Bay	596	Mr. Chipman & W. Compton	08 77	04	50	6	7				
Spaniards Bay	597	Tom Sheppard	08 77	04	50	6	24				
Spaniards Bay	598	Henry Smith	04 69	03	100	6	30	34	1.5		
Spaniards Bay	599	Town Council	11 72	03	103	6	22	8	6		
Spaniards Bay	600	Anglican Board of Education	10 61	05	95		26				
Spaniards Bay	601	Ray Barrett	09 75	04	90	6	17				
Sunnyside	602	G. Anderson	03 70	02	340		27		1	MU	
Sunnyside	603				130				2.5	MU	
Sunnyside	604	D.M.A.H.	02 74	05	220				< .5		
Sunnyside	605	D.M.A.H.	02 74	05	220				5-6		
Sunnyside	606	Boyd Adams	09 79		200	6					
Sunnyside	607	Lloyd Adams	09 79	01	170	6	40		1	DO	0-38 sand and gravel 38-170 shale

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Swift Current	608	D.M.A.H.	08 73	05	154	6	14	3.5	3		
Swift Current	609	Mr. Dhadia D.M.A.H.	02 73	05	62		12	25			
Swift Current	610	J.G.S. Ltd.	01 71	02	54						
Swift Current	611		10 75	01	220		31.5				
Swift Current	612	Irving Oil	07 75	05	110		74		12		
Swift Current	613	Bonavista Trinity Placentia Integrated School Board	06 73	03	265	6	26		3		
Thickett	614	D.M.A.H.	05 73	05	215		28		3		
Thickett	615	D.M.A.H.			210	6		18	3.5		
Tilton	616	D.M.A.H.	12 74	01	250	6			3		0-17.5 overburden 17.5-250 bedrock
Tilton	617	D.M.A.H.	12 74	01	242	6			2.5		0-22 overburden 22-242 bedrock
Tilton	618	Wm. Brown	07 75	04	60	6	25				
Tilton	619	Jack Highmore	06 77	01	166	6	30	4	1		0-22 overburden 22-166 siltstone and slate
Upper Island Cove	620	Town	03 75	01	322	6			4	MU	0-11 overburden 11-322 bedrock
Upper Island Cove	621				220			85	4		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Upper Island Cove	622	D.M.A.H.	08 75		214	6 8	45 40	30.8	12.5		0-40 overburden 40-214 bedrock
Upper Island Cove	623	Town Council	08 70	03	250		15	35	2		
Upper Island Cove	624	A. Bishop	09 73	03	118	6	70	25	4		
Upper Island Cove	625	Town Council	09 76	04	100	6					
Upper Island Cove	626	Town Council	08 71	03	100	6	22	3	15		
Upper Island Cove	627		08 71	03	230		42	10	4		
Upper Island Cove	628	Town Council	04 70	03	246	6	20	7	8		
Upper Island Cove	629	Town Council	07 70	03	275	6	21		4		
Upper Island Cove	630	Tea Lynch	05 77	04	105	6	7				
Upper Island Cove	631	Town Council	12 71	03	145		18	14	3		
Upper Island Cove	632	Town Council	12 71	03	56		16		1.5		
Upper Island Cove	633	Osbourne Brothers	06 71	03	140		21	25	4		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Upper Island Cove	634	Town Council	08 77	01	320		22		0.5	MU	0-2 topsoil 2-320 slate
Upper Island Cove	635	Community	08 77		134	6		23.3	1		
Victoria	636	Aubry Rose	07 73	03	76		26				
Victoria	637	Pastor Dalley	66		115	8		40	14		0-21 overburden 21-115 bedrock
Victoria	638	Government	66		102	6		27	8		0-30 overburden 30-102 bedrock
Victoria	639	L. Ennis	64		60	6		30	1.5		0-35 overburden 35-60 bedrock
Victoria	640	W. Stevenson	62		100	8		50			0-55 overburden 55-100 bedrock
Victoria	641	G. Clarke	66		123	6		8	6.5		0-20 overburden 20-123 bedrock
Victoria	642	Wm. Vaters	09 64	03	60		30				
Victoria	643	Town Council	02 72	03	100		34	5	8		
Victoria	644	Ruby Keeping	11 69	03	45		18				
Victoria	645	D.M.A.H.	04 69	03	195	6	47				
Victoria	646	Comm. & Soc. Development	10 71		158	6		4.5	8		
Victoria	647	R. Coveyduck	12 71	03	93		26		3		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Victoria	648	Town Council	02 73	03	92	6	33	14	14		
Victoria	649	Mr. Baldwin	12 66	03	49						
Victoria	650	H. Clarke	07 72	03	67	6	35				
Victoria	651	Ivany Hiscock	07 72	03	66		30		5		
Victoria	652	Gordon Clark	11 66	03	121	6	28	2	8		
Victoria	653	H. Clarke	10 65	03	38		20				
Victoria	654	J. A. Clarke	09 68	03	80		34	20			
Victoria	655	L. Annis	64	03	56		11	16	1.5		
Victoria	656	Saunders and Howell Ltd.	10 64	03	98		39	20	4.5		
Victoria	657	Harmon Industrial Ltd.	12 74	03	106	8	22				
Victoria	658	Victoria Town Council	06 73	03	106	6	30				
Victoria	659	John Slade	12 75	03	55	6	13				
Western Bay	660	D.M.A.H.		03	177		22		25		
Western Bay	661	Comm. & Soc. Development	07 71		198	6		14.5	1		
Western Bay	662	D.M.A.H. C. Penney	09 75		175	6		9	90		

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Western Bay	663	Ches Rowe	07 73	03	143		25				
Western Bay	664	D.M.A.H.	08 75	03	180		30	10	3		
Western Bay	665	United Church Regional High School	62		140-180						
Western Bay	666	Comm. & Soc. Development	08 71	05	200		22		0.5		
Western Bay	667	H. Walters	10 76	03	173		28	20	4		
Western Bay	668	D.M.A.H.	09 73	03	178	6	30	7	15		
Western Bay	669	Post Office	10 76	03	177		28	20	4		
Western Bay	670	Grayson Penny	77	05	70		12				
Western Bay	671	Ed Pottle	08 74	03	103		26		4		
Western Bay	672	H. Roberts	07 73	03	92	6	39				
Western Bay	673	W. Reid	12 72	03	160	6	30				
Western Bay	674	R. Young	07 73	03	131		32		5		
Western Bay	675	R.C. School Board	08 68	03	115		20	2	5.5		
Western Bay	676	H. Sellars	09 79		40	6					
Western Bay	677	George Vaters	10 78		190	6					
Western Bay	678	Ted Norman	07 78	01	60	6	22		8	DO	0-13 sand and gravel 13-60 shale

WATER WELL RECORD SUMMARY

Community	Well No.	Owner	Date	Driller	Depth	Casing		Static Water Level	Yield	Water Use	Lithology
						Dia.	Lgth.				
			mo/yr		ft	in	ft	ft	gpm		
Weybridge	679	Otto Pitcher	10 75	01	56	6		2		DO	0-14.5 overburden 14.5-56 bedrock
Whiteway	680	Comm. & Soc. Development	11 70		275	6		13	3		
Whiteway	681	D.M.A.H. F. Jackson John Legge	12 75	05	205		21	6	6		
Whiteway	682	D.M.A.H. E. Hefford	07 75	05	183		22		3		
Winterton	683	D.M.A.H.	07 63	05	206		7		2.5		

APPENDIX C

GROUND WATER CHEMISTRY DATA

APPENDIX C

GROUND WATER QUALITY DATA

LOCATION	SAMPLE NO.	pH	Ca	Mg	Na	K	ALKALINITY	HARDNESS	SO_4	Cl	NITRATE	NITRITE	PHOSPHATE	Fe	Mn	Cu	Pb	Zn	Cd	COLOR	TDS	TURBIDITY	CONDUCTIVITY
Hodgewater Group																							
Adairs Cove	1	6.4	16.5	2.5	20	3.8	34.8	51.4	12.05	28	3.9	0.1	0.73	0.56	0.68	0.02	0.01	0.05	<.001	>100	129.5	43	221
Bareneed	2	8.1	21.9	2.8			106.6	66.8		82	<.005	0.1	0.17	0.02	0.01	0.006	<.002	0.14	.001	5		20	295
Bay de Verde	3	6.1	26.3	6.2			7.8	92.1		113	1.0		0.0	0.14	0.27	0.11		0.0	.002	20		1.3	640
Bay de Verde	4	4.5	6.2	6.1				41.3		90	0.27		0.43	0.19	0.30	0.07		0.36	.003	50		4.0	425
Bay de Verde	5	5.7	9.5	10.6			4.0	68.8		147	0.21			0.04	0.66					5	300	0.08	496
Bay de Verde	6	5.9	22.3	4.7			6.2	75.7		92	0.71			0.04	0.33					15	307	0.08	477
Bay de Verde	7	8.2	5.3	2.2			8.2	22.3		18.5	0.18			0.62	0.08					50	121	0.08	161
Bay de Verde	8	5.2	14.8	14.4			13.6	98		270	0.44			0.06	0.81					5	513	9.5	719
Bay de Verde	9	5.3	8.4	7.2			0.8	52.1		66	0.26		0.0	0.02	0.8	0.07		.003	.002	5		0.28	374
Bay de Verde	10	5.3	37.4	11.4			2.6	142		127	0.35		0.001	0.01	0.70	1.55		0.56	.007	5		0.70	742
Bay Roberts	11	7.8	79.2	8.4			103	233			0.0		0.0	0.19	0.42	ND		0.10	ND	10		4.05	477
Bay Roberts	12	5.7	7.0	2.0	12		13.2	26	8.0	21.5	.567	<.005	.006	0.04	0.11	0.02	.003	0.02	<.001	5	75	0.15	125
Broad Cove	13	8.4	4.8	0.16				15.2	4.6	17	.205			0.02	0.02		<.01			5		1.0	212
Cavendish	14	8.0	23	5.0	22	2.2	106	78	3.5	16.7	<.005	0.1	0.12	0.02	0.16	<.002	0.004	0.04	<.001	<5	144.9	0.13	244
Dildo	15	7.25	31.5	6.56					8.6	20.4	0.474			0.048	0.01		<.01			5	123	1.16	256.4
Dildo South	16	6.3	11	3.0	9	1.4	43.5	39.7	6.6	9.0	0.36	0.1	0.20	0.45	0.85	0.009	0.002	0.14	<.001	10	77.8	4.5	131
Dildo South	17	8.3	14	4.0	26	2.6	76.1	51.3	19.7	11.5	<.005	<0.1	0.15	0.08	0.02	<.002	0.002	0.008	<.001	<5	133	1.0	210
Dildo South	18	7.5	29.3	8.86				109.9	15.1	26.9	<.005			0.13	0.06		<.01			5		0.95	269
Dildo South	19	6.8	4.8	2.2			20.8	24.4			0.045		0.038	1.8	0.05	0.0		0.41	0.0	60		10.2	412
Dildo South	20	7.1	144	36	188		72	508		435	0.95	<.005	0.033	0.12	2.65	.005	0.001	0.360	<.001	<5	999	0.19	1540

NOTES:

1. All values in mg/l unless otherwise specified
2. Alkalinity as $CaCO_3$
3. Hardness as $CaCO_3$
4. Nitrate and nitrite as N
5. Phosphate - inorganic
6. Color as True Color Units (T.C.U.)
7. TDS - total dissolved solids
8. Turbidity as Jackson Turbidity Units (J.T.U.)
9. Conductivity as micromhos/cm
10. ND - not detected

APPENDIX C

GROUND WATER QUALITY DATA
(cont'd)

LOCATION	SAMPLE NO.	pH	Ca	Mg	Na	K	ALKALINITY	HARDNESS	SO_4	Cl	NITRATE	NITRITE	PHOSPHATE	Fe	Mn	Cu	Pb	Zn	Cd	COLOR	TDS	TURBIDITY	CONDUCTIVITY
Grates Cove	21	7.9	29.8	7.9				107	1.4	28.4	.021			<0.01	0.11		<0.01			5	46	0.95	408.9
Grates Cove	22	7.8	23.0	5.6				8.1	7.4	28.4	.018			0.02	0.11		<0.0			5	48	0.95	254.3
Grates Cove	23	7.0	25.9	8.4				101.4	15.4		<.005			0.25	0.84		<0.01			50	114	0.95	372
Grates Cove	24	6.3	8.5	2.8				34.4			0.017			0.56	0.42					25	162	4.5	311.9
Grates Cove	25	6.96	3.8	2.2				19.8			ND		0.01	0.45	0.12	ND		0.01		50		0.45	176.9
Greens Harbour	26	6.5	8.6	2.6				32.5	3.8	22.7	2.43			0.20	0.01		<.01			5		0.95	148.7
Greens Harbour	27	7.9	21.7	6.0	9.0		68	78.8	7.0	11.0	0.16	0.015	0.13	1.0	22	9.3	0.10	5.4	.003	ND	162	4.2	230
Greens Harbour	28	7.0	13.4	6.0	8.0		47	58.2	6.0	11.7	0.20	0.015	0.10	1.1	2	0.8	0.03	0.54	.001	ND	109	110	217
Greens Harbour	29	7.2	20	5.0	10	1.4	76.1	70.4	5.0	13.6	0.043	<0.1	0.15	0.02	0.02	<.002	0.002	0.095	<.001	<5	109	0.1	193
Greens Harbour	30	7.05	18	4.0	12	1.9	69.8	61.3	5.4	13.6	0.02	<0.1	0.16	0.11	0.14	.005	0.002	0.44	<.001	<5	107.5	0.29	164
Greens Harbour	31	7.7	29	4.0	13	1.9	105	88.8	6.1	10.3	0.04	<0.1	0.12	0.05	0.06	<.002	0.002	0.11	<.001	<5	137.2	0.1	234
Greens Harbour	32	7.7	23	4.0	12	1.5	82	78.8	5.3	11.5	0.027	<0.1	0.15	0.09	0.03	<.002	0.002	0.07	<.001	<5	115.6	1.8	182
Greens Harbour	33	8.0	20	3.0	15	1.6	83.6	62.2	3.2	9.3	<.005	<0.1	0.16	0.06	0.02	<.002	0.002	0.011	<.001	<5	111.2	2.8	176
Harbour Grace	34	7.4	29	3.0	9.1	0.8	84.8	84.8	8.3	8.2	<.005	0.1	0.17	0.02	0.01	.006	<0.002	0.14	0.001	5	110	0.1	195
Lower Island Cove	35	6.98	31.3	7.3	12	1.7	92.5	108	14.7	15.1	0.13	0.1	0.16	0.46	2.5	<.002	0.007	1.25	0.001	<5	148.8	4.1	234
Lower Island Cove	36	7.89	47.8	8.0	12	2.6	127	152	20.0	21.3	<.005	<0.1	0.19	0.11	0.18	<.002	0.002	0.09	<.001	<5	200	0.76	317
New Harbour	37	9.2	0.8	0.26			97.6	3.6			.003		.002	0.28	0.0	0.0		0.26	0.0	10		4.2	241
Northern Bay	38	7.5	61	8.0	25	1.7	143	186	16	43	0.4	0.02	0.15	0.28	4.85	4.8	<0.002	0.06	<.001	5	270.9	0.4	445
Old Perlican	39	5.8	1.25	1.14			2.9	7.1			3.86		0.042	0.05	0.10	0.16		0.21	0.00	80		0.25	112
Old Perlican	40	8.0	16	5.35			134.9	62.1			.098		0.07	0.00	0.09	0.18		0.195	0.26	5		0.1	732

NOTES:

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2. Alkalinity as $CaCO_3$
3. Hardness as $CaCO_3$
4. Nitrate and nitrite as N
5. Phosphate - inorganic
6. Color as True Color Units (T.C.U.)
7. TDS - total dissolved solids
8. Turbidity as Jackson Turbidity Units (J.T.U.)
9. Conductivity as micromhos/cm
10. ND - not detected

APPENDIX C

GROUND WATER QUALITY DATA

(cont'd)

LOCATION	SAMPLE NO.	pH	Ca	Mg	Na	K	ALKALINITY	HARDNESS	SO_4	Cl	NITRATE	NITRITE	PHOSPHATE	Fe	Mn	Cu	Pb	Zn	Cd	COLOR	TDS	TURBIDITY	CONDUCTIVITY
River Head	41	7.85	25.9	6.75				92.9	24.8	151.7	0.19			0.19	0.04		<.01			5	216	1.5	654
Salmon Bay	42	7.6	32.5	5.8	10.2	0.6	99.5	105	9.9	8.4	0.01	0.1	0.13	0.06	0.44	.004	<.002	0.08	<.001	5	135.5	0.04	226
Salmon Cove	43	7.5	53.6	2.3				145.8	7.7		0.04			0.4	0.9		<.01			10	272	1.45	333
Spaniards Bay	44	7.5	17.3	1.6			19	51.5			0.006		0.0	0.62	0.25	.0		.025	.0	5		12.95	148
Victoria	45	7.7	41.3	7.5	12.0	0.8	117	134	13.1	14.4	0.03	<0.1	0.20	0.13	0.07	.002	<.002	.03	<.001	<5	16.8	1.5	274
Western Bay	46	7.8	34.5	10.0	10.8	0.8	115.8	127	11.7	12.8	0.02	0.1	0.25	3.1	0.07	.01	.01	.08	<.001	5	151	0.3	261
											Musgravetown Group													
Hickmans Hbr	47	6.4	17.2	1.9			46.4	51.1			0.69		0.0	0.11	0.02	0.05		0.55	ND	10		1.25	354
Little Hearts Ease	48	6.5	2.2	0.85				104	4.5	28.2	0.46		0.11	0.78	0.04		<.01			15	95	1.58	125
Little Hearts Ease	49	8.55	12.7	1.8				39.5	4.0	16.6			0.12	0.17	0.01		<.01			<5	143	1.9	261
Shoal Harbour	50	6.8	14.6	1.9				44.4		93.6	2.03			<0.01	0.04					7.5	294	0.85	387
Shoal Harbour	51	7.1	34.4	4.2				102		144.6	2.23			<0.01	0.01					10	697	0.57	558
											Conception Group													
Bishops Cove	52	7.7	31.5	7.7				110		10.2	0.75			0.06	0.14					5		0.45	
Byrant Cove	53	8.1	27.6	5.0				89.5	25	18	1.4			0.03	0.05		<.01			5	153	0.80	241
Port de Grave	54	6.35	16.4	6.3				68.9		60	0.10			0.37	0.70					50	327	1.9	493
Upper Island Cove	55	7.9	72.2	1.39				189			7.96				0.57					5	374	0.98	635

NOTES:

1. All values in mg/l unless otherwise specified
2. Alkalinity as $CaCO_3$
3. Hardness as $CaCO_3$
4. Nitrate and nitrite as N
5. Phosphate - inorganic
6. Color as True Color Units (T.C.U.)
7. TDS - total dissolved solids
8. Turbidity as Jackson Turbidity Units (J.T.U.)
9. Conductivity as micromhos/cm
10. ND - not detected

APPENDIX D

DISCUSSION OF SELECTED PARAMETERS

APPENDIX D
DISCUSSION OF SELECTED PARAMETERS

Calcium:

It is associated with silicate minerals found in both igneous and metamorphic rocks and although it can be released by weathering, the dissolution process is typically very slow. In sedimentary rocks, it is commonly associated with carbonates and may be found in limestone, dolomite and evaporate minerals; the carbonate cement found in many sedimentary rocks, is another important source of calcium. Typically, calcium is the major contributor to water hardness and a major component in the value for total dissolved solids. No limit currently exists for calcium concentration in drinking water.

Magnesium:

Ferromagnesium minerals - olivine, pyroxine and amphibole, in igneous rocks and chlorite, montmorillonite and serpentine minerals in metamorphic rocks, are the primary sources of magnesium. As with calcium, magnesium dissolution from these sources is usually a very slow process. In sedimentary rocks it is generally associated with carbonates, dolomite being an important magnesium carbonate. An important contributor to water hardness and TDS, its concentration

is usually substantially lower than that of calcium in natural waters. No limit currently exists for magnesium concentration in drinking water.

Sodium:

Its primary source in igneous rocks, is the feldspar minerals while in sedimentary rocks, it is the evaporites - as an impurity of carbonate minerals or associated with salts precipitated during past marine inundations. Clayey minerals may provide an important source for sodium release into natural waters. Anomalous concentrations of sodium in ground waters can usually be associated with road salt contamination, sea water intrusion, marine aerosols, natural formation salts or brine solutions. No limit currently exists for sodium in drinking water, however, a limit of 20 mg/l has been suggested for people on low salt diets.

Sulfate:

Evaporate deposits (gypsum and anhydrite) associated with sedimentary rocks are the most important sources of sulfate; metallic sulfides in both igneous and sedimentary rocks are important additional sources. Substantially elevated and excessive sulfate values (i.e. >500 mg/l), can produce a noticeable taste in drinking water and cause

catharsis and gastrointestinal irritation (Gibb and McMullin, 1980). A recommended limit of 500 mg/l has been established.

Chloride:

Sedimentary rocks such as evaporites, including halite, or fine grained rocks impregnated with salts, following submersion by ancient seas, are major sources of chloride. Feldspathoid and phosphate minerals in igneous rocks are less important sources. In recent time, road salt and sea water intrusion have locally increased the chloride concentrations in ground waters. Elevated values of chloride may effect the taste of water and water based beverages. Higher values will increase the ionic strength of ground water and may become responsible for increased values of nuisance minerals like iron and manganese. A recommended limit of 250 mg/l has been established.

Nitrate:

This is the most prevalent form of nitrogen in aqueous solutions, although nitrite and ammonia may also be present. Biological material (vegetation, animal matter, etc.) is the most important source of nitrogen (excluding the atmosphere) and the soil horizon plays a key role in nitrogen reactions. Biological and biochemical reactions

generally control the reduced or oxidized form in which nitrogen will be found in ground water. Elevated values of nitrate, nitrite and ammonia may indicate well contamination related to human or animal waste. Nitrate values greater than 10 mg/l (as N) have been attributed to causing infant methaemoglobenima. A recommended limit of 10 mg/l (as N) has been established for nitrate.

Iron and Manganese:

Both these elements are commonly associated with many minerals in all rock types; manganese may also be derived from organic reactions. The oxide and sulfide iron minerals are the major contributors to iron concentrations in ground waters. They are the most common nuisance constituents in ground water supplies and often, but not always, both will occur as problem elements. Elevated values for iron and manganese do not pose a health hazard but will stain laundry and plumbing fixtures and/or impart a taste or smell to drinking water. Recommended limits of 0.3 and 0.05 mg/l have been established for iron and manganese respectively, based on aesthetic considerations.

Hardness:

It is defined as the concentration of metallic

ions (principally Ca^{2+} and Mg^{2+}) which react with sodium soaps to produce insoluable soaps or scummy residues, these will form incrusting deposits if the water is heated to evaporation as in boilers (Freeze and Cherry, 1979). Extremely soft waters are usually corrosive (Gibb and McMillin, 1980). Values in excess of 180 - 200 mg/l are considered to be unacceptable while values in the 80 - 100 mg/l range are optimal.

pH:

This is the measure of the hydrogen ion activity in water and is used to determine its acidic or alkaline nature. A logrithmic scale of measurement is used since the concentrations of H^+ encountered in natural waters is typically quite low. A range of 6.5 to 8.5 is considered optimal, with lower and higher values enhancing corrosion or incrustion respectively.

54°30'

54°15'

54°00'

53°45'

53°30'

53°15'

48° 15'

48° 00'

TRINITY NORTH DISTRICT

TRINITY

CLODE SOUND

NATIONAL TRANS-CANADIAN HIGHWAY

NATIONAL TRANS-CANADIAN HIGHWAY

TRINITY NORTHWEST

TRINITY SOUTHWEST

BONAVISTA TRINITY

Port Blandford

Musgravetown

Bloomfield

Hillview

Milton

Mills Siding

Harcourt

Gin Cove

Monroe

Whitesville

Weybridge

Lady Cove

Hillview

Princeton

Southern Bay

Charleston

Ocean Pond

Lady Pond

Trouty

Goose Cove

Old Bonaventure

New Bonaventure

Bonaventure Head

Kerleys Harbour

Pipers Harbour

Pipers Harbour Pond

Delbys Cove

Bridgett Harbour

Snooks Harbour

Ellis Cove

Lockston

Port Rexton

English Harbour

Portland

Bonavista

Indian Lookout

Fire Lookout

Big Codger Pond

Saddle Back Pond

Blue Gull Pond

Trouty Pond

Cross Pd

Juniper Pds

Dalton Pd

Matthews Pond

Northeast Pond

Midway Pd

Rapids

Lady Pond

Second Pond

Rocky Pond

Big Pond

Gull Pond

Ryders Brook

Georges Brook

Thorburn Lake

Northwest Pond

Southwest Arm

Northwest Arm

Southwest Brook

Rapids Brook

Sandy Pd

Rocky Pd

Fogans Pond

Sattlings Pond

Grandfathers Pd

Winter Brook

Pinsents Pond

Mollygoojack Lake

Salmon Pond

Western Pond

Red Indian Pond

Island Pond

Sheep Pond

Shoal Harbour Pond

Queen Pond

Tea Pond

Frost Pond

Sparrowhawk Brook

Red Brook

Middle Pond

Northwest Pond

Rocky Pond

Big Pond

Gull Pond

Ryders Brook

Georges Brook

Thorburn Lake

Trans-Canada Highway

Shoal Harbour River

Sparrowhawk Brook

Red Brook

Western River

Salmon River

Mollygoojack Lake

Pinsents Pond

Northwest Pond

Rapids

Salmon Pond

717

852

1083 Fire

1109

Bl

Fire Lookout

Big Codger Pond

Blue Gull Pond

Saddle Back Pond

Trouty Pond

Cross Pd

Juniper Pds

Dalton Pd

Matthews Pond

Northeast Pond

Midway Pd

Rapids

Lady Pond

Second Pond

Rocky Pond

Big Pond

Gull Pond

Ryders Brook

Georges Brook

Thorburn Lake

Northwest Pond

Southwest Arm

Northwest Arm

Southwest Brook

Rapids Brook

Sandy Pd

Rocky Pd

Fogans Pond

Sattlings Pond

Grandfathers Pd

Winter Brook

Pinsents Pond

Mollygoojack Lake

Salmon Pond

Western Pond

Red Indian Pond

Island Pond

Sheep Pond

Shoal Harbour Pond

Queen Pond

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Rapids

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Rocky Pond

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Ryders Brook

Georges Brook

Thorburn Lake

Northwest Pond

Southwest Arm

Northwest Arm

Southwest Brook

Rapids Brook

Sandy Pd

Rocky Pd

Fogans Pond

Sattlings Pond

Grandfathers Pd

Winter Brook

Pinsents Pond

Mollygoojack Lake

Salmon Pond

Western Pond

Red Indian Pond

Island Pond

Sheep Pond

Shoal Harbour Pond

Queen Pond

Tea Pond

Frost Pond

Sparrowhawk Brook

Red Brook

Middle Pond

Western River

Salmon River

Trans-Canada Highway

Shoal Harbour River

Sparrowhawk Brook

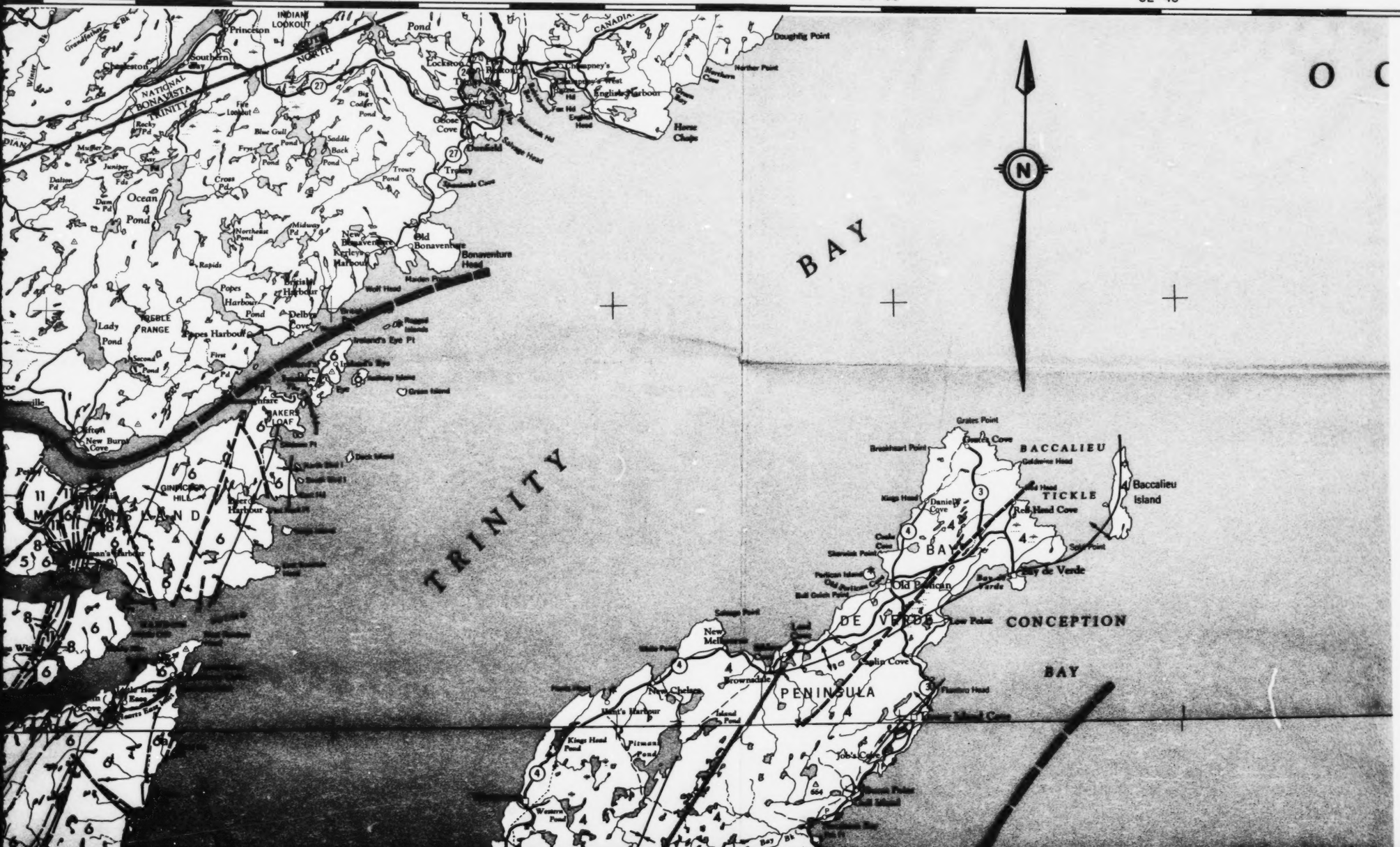
Red Brook

Middle Pond

Western River

Salmon River

53°45' 53°30' 53°15' 53°00' 52°45' 52°30' 52°15'


TRINITY
BAY
CONCEPTION
BAY
PENINSULA
DE VERDE
BACCALIEU
TICKLE
Baccalieu Island
Cape St. Francis
Princeton
Southern Bay
Charleston
Ocean Pond
Lady Pond
Pipers Harbour
Old Bonaventure
Bonaventure Head
Old Perlican
Bay de Verde
Low Point
Flatrock Head
Brownsdale
New Chelsea
Heart's Harbour
Kings Head
Pitman Pond
Island Pond
Job's Cove
Western Pond
Broad Cove
Salmon Cove
Dildo Run
Carbonear Island
Harbour Grace
Conception Harbour
Conception Bay South
Bell Island
Portugal Cove
Topsail
Paradise
Mount Pearl
St. John's
Petty Harbour
Bay Bulls
Witless Bay
Witless Bay Islands
Ferryland
Aquaforte
Calvert
Cape Broyle
Cape Race
Cape Pine
Admiral's Cove
Trepassey
Mobile
Biscay Bay
Placentia
Argentia
Dunville
Jerseyside
Fox Harbour
Long Harbour
Arnold's Cove
Come By Chance
Goobies
Clarke's Beach
Whitbourne
Avondale
Colliers
Bay Roberts
Spaniard's Bay
Upper Island Cove
Cupids
Brigus
Port de Grave
Bareneed
Holyrood
Conception Harbour
Kelligrews
Foxtrap
Manuels
Seal Cove
Tors Cove
Tors Cove Hills
Pigeon Cove Hills
Gibbet Hill
Hodge Hill
Mount Carmel
Mount Misery
Mount Pleasant
Mount Hope
Mount Kelly
Mount Cashel
Mount Scio
Mount Sylvia
Mount Peyton
Mount Dundas
Mount Carson
Mount Alexander
Mount Wise
Mount Cormack
Mount Sparrow
Mount Kilbride
Mount Thomas
Mount Hayward

53°00' 52°45' 52°30' 52°15' 52°00' 51°45'

48°15'

48°00'

LEGEND

AVALON ZONE

WESTERN AVALON ZONE

EASTERN AVALON ZONE

PLUTONIC ROCKS

DEVONIAN AND EARLIER

15 Massive, pink, coarse-grained to megacrystic biotite granite. Less acidic and finer-grained around Placentia Bay.

14 Predominantly diorite, gabbro and diabase.

CAMBRIAN

Middle and Upper Cambrian

13 HARCOURT GROUP – Grey to black shale or slate and siltstone, minor black limestone. In part Lower Ordovician age.

Lower and Middle Cambrian

11 ADEYTOWN GROUP – Red, green and purple shale and slate; minor grey, pink and green limestone; thin, white calcareous sandstone at base.

Upper Cambrian

12 ELLIOT COVE FORMATION – Black and dark grey shale with limestone nodules, minor limestone, siltstone.

Middle Cambrian

10 CHAMBERLAINS BROOK AND MANUELS RIVER FORMATIONS – Black, grey, green and red slate with some limestone nodules. Andesitic pillow lavas and breccias in Chapel Arm Area.

Lower Cambrian

9 BONAVISTA, SMITH POINT AND BRIGUS FORMATIONS – Red and green slate, commonly with limestone nodules; Pink algal limestone; minor conglomerate at base.

8 RANDOM FORMATION – Predominantly white quartzite and quartz pebble conglomerate.

HADRYNIAN AND EARLIER

6 MUSGRAVETOWN GROUP – Red, green and grey arkose, siltstone, conglomerate and slate. Minor lava and tuff.
6a – BULL ARM FORMATION and equivalents – Acidic to basic volcanic flows, breccias and tuffs; some interbedded sedimentary rock.

4 HODGEWATER GROUP – Grey to green siltstone, arkose and slate, minor conglomerate.

CAMBRIAN OR EARLIER

7 Medium grained, massive to foliated, biotite hornblende granite, granodiorite and syenite.

48° 00'

47° 45'

47° 30'

TRINITY NORTH DISTRICT

TRINITY SOUTH DISTRICT

PLACENTIA WEST DISTRICT

TRINITY SOUTH DISTRICT

TRINITY NORTH DISTRICT

TRINITY BAY

TRINITY BAY

TRINITY BAY

Lower Cambrian

11 ADEYTOWN GROUP – Red, green and purple shale and slate; minor grey, pink and green limestone; thin, white calcareous sandstone at base.

10 RIVER FORMATI… and red slate with… Andesitic pillow la… Arm Area.

9 BONAVISTA, SMIT… FORMATIONS – R… commonly with lim… limestone; minor c…

8 RANDOM FORMA… white quartzite an… conglomerate.

HADRYNIAN AND EARLIER

6 MUSGRAVETOWN GROUP – Red, green and grey arkose, siltstone, conglomerate and slate. Minor lava and tuff.
6a – BULL ARM FORMATION and equivalents – Acidic to basic volcanic flows, breccias and tuffs; some interbedded sedimentary rock.

4 HODGEWATER GR… siltstone, arkose a… conglomerate.

5 CONNECTING POINT GROUP – Green to black greywacke, cherty quartzite slate; some sandstone and conglomerate. Numerous andesitic dykes and sills probably related to 6a.

3 CONCEPTION GR… slate, siltstone, gre… red siltstone.

2 LOVE COVE GROUP – Weakly metamorphosed basic to acidic volcanic rocks; sandstones and conglomerates.
2a – SOUND ISLAND FORMATION and equivalents. Acidic to basic volcanic flows and tuffs, minor interbedded sandstone and conglomerate.
2b – Sandstone, siltstone, greywacke and conglomerate; minor metavolcanic rocks.

1 HARBOUR MAIN GROUP – Acidic to basic volcanic rocks; minor greywacke, conglomerate and siltstone.

Geological boundary – Defined, approximate.

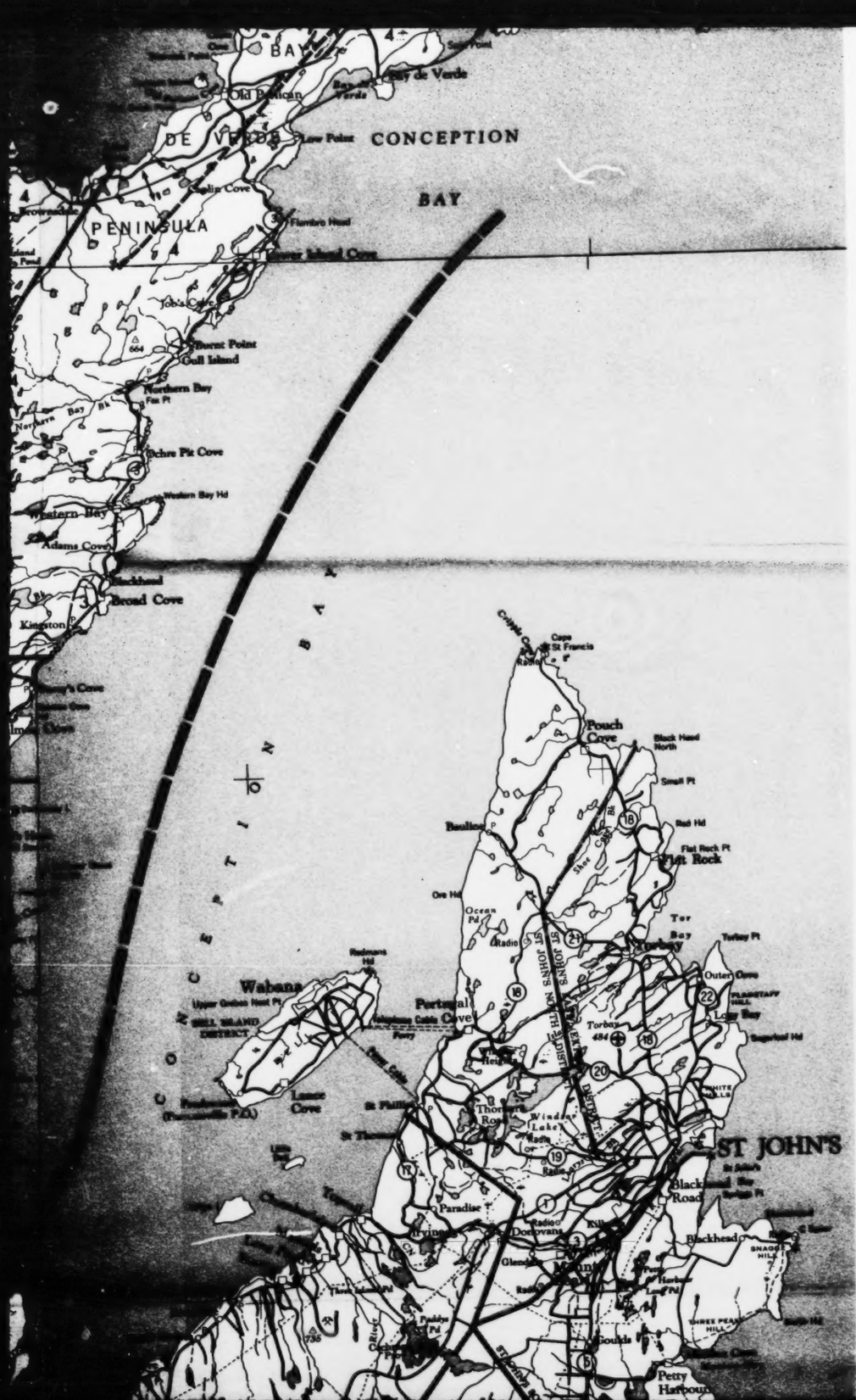
Fault – Defined, approximate, assumed.

Thrust fault – Teeth in direction of dip.

Axial plane of anticline – Arrow in direction of plunge.

Axial plane of syncline – Arrow in direction of plunge.

DEPARTMENT …
GOVERNMENT OF NEWFO…



Lower Cambrian

9 BONAVISTA, SMITH POINT AND BRIGUS FORMATIONS – Red and green slate, commonly with limestone nodules; Pink algal limestone; minor conglomerate at base.

8 RANDOM FORMATION – Predominantly white quartzite and quartz pebble conglomerate.

HADRYNIAN AND EARLIER

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6a – BULL ARM FORMATION and equivalents – Acidic to basic volcanic flows, breccias and tuffs; some interbedded sedimentary rock.

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2b – Sandstone, siltstone, greywacke and conglomerate; minor metavolcanic rocks.

1 HARBOUR MAIN GROUP – Acidic to basic volcanic rocks; minor greywacke, conglomerate and siltstone.

11 shale and slate; minor grey, pink and green limestone; thin, white calcareous sandstone at base.

Andesitic pillow lavas and breccias in Chapel Arm Area.

4 HODGEWATER GROUP – Grey to green siltstone, arkose and slate, minor conglomerate.

3 CONCEPTION GROUP – Greyish-green slate, siltstone, greywacke; minor conglomerate, red siltstone.

7 Medium grained, massive to foliated, biotite hornblende granite, granodiorite and syenite.

Geological boundary – Defined, approximate.

Fault – Defined, approximate, assumed.

Thrust fault – Teeth in direction of dip.

Axial plane of anticline – Arrow in direction of plunge.

Axial plane of syncline – Arrow in direction of plunge.

48°00'

47°45'

47°30'

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

47° 45'

47° 30'

54° 30'

54° 15'

54° 00'

53° 45'

53° 30'

53° 15'

1 HARBOUR MAIN GROUP – Acidic to basic volcanic rocks; minor greywacke, conglomerate and siltstone.

Geological boundary – Defined, approx

Fault – Defined, approximate, assumed

Thrust fault – Teeth in direction of d

Axial plane of anticline – Arrow in di

Axial plane of syncline – Arrow in di

GOVERNM

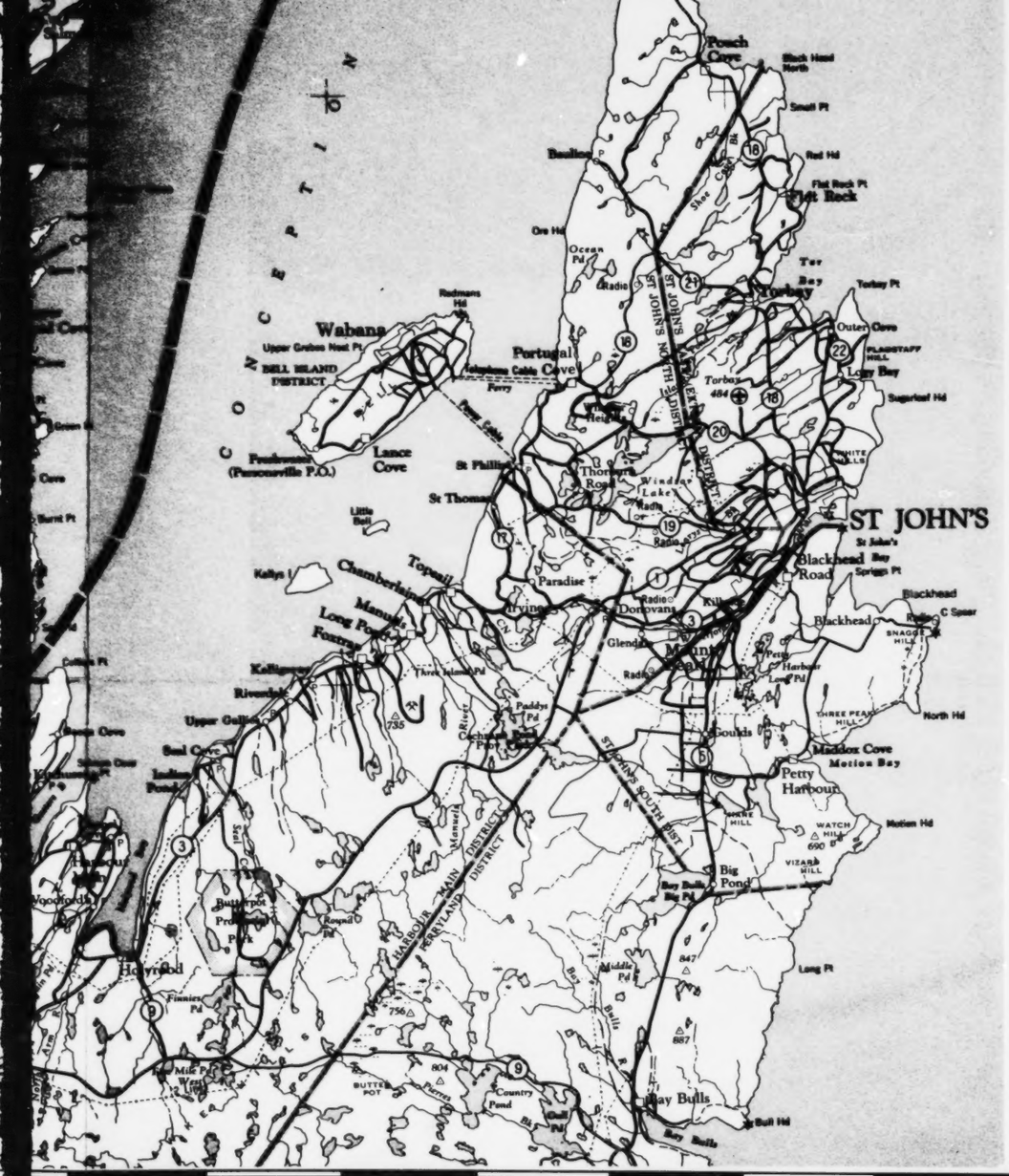
BED

HYDROGEO

5 0

NOLA

53° 45' 53° 30' 53° 15' 53° 00' 52° 45' 52° 30'



53°00' 52°45' 52°30' 52°15' 52°00'

47°45'

47°30'

1 HARBOUR MAIN GROUP – Acidic to basic volcanic rocks; minor greywacke, conglomerate and siltstone.

Geological boundary – Defined, approximate.

Fault – Defined, approximate, assumed.

Thrust fault – Teeth in direction of dip.

Axial plane of anticline – Arrow in direction of plunge.

Axial plane of syncline – Arrow in direction of plunge.

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

BEDROCK GEOLOGY

HYDROGEOLOGY OF TRINITY BAY AREA

1982

MAP 1

Scale 1 : 250,000

5 0 5 10 15 20 25

KILOMETRES

NOLAN, DAVIS & ASSOCIATES LIMITED

54°30' 54°15' 54°00' 53°45' 53°30' 53°15'

48°15'

48°00'

TRINITY

TRINITY NORTH DISTRICT

PLACENTIA WEST DISTRICT

TRINITY SOUTH DISTRICT

CROWN

RANDOM ISLAND

Port Blandford

Musgravetown

Bunyan's Cove

Bloomfield

Brooklyn

Lethbridge

Portland

Princeton

Southern Bay

Charleston

Locksley

Trinity

Dunfield

Goose Cove

Trouty

Old Bonaventure

New Bonaventure

Bonaventure Head

Kerleys Harbour

Popes Harbour

British Harbour

Delbys Cove

Ireland's Eye

Ragged Islands

Harcourt

Gin Cove

Monroe

Waterville

White Rock

Clarenville

Snooks Harbour

Elliott's Cove

Petley

Britannia

Hickman's Harbour

Lady Cove

Lady Point

Adeytown

Idnes Within

Hillview

North West Brook

Queen's Cove

Hodge's Cove

Islands Pond

Long Beach

Southport

Long Island

Blackberry Cove

Southeast Point

West Random Head

East Random Head

Verge Island

Flat Rock Pt

Silldown Pt

Duck Island

North Bird I

South Bird I

East Hd

Ocean Pond

Lady Pond

Rocky Pond

Second Pond

Northeast Pond

Midway Pd

Big Coaker Pond

Blue Gull Pond

Saddle Back Pond

Trouty Pond

Spanserds Cove

Salvage Head

Fox Hd

English Head

Chapmpney's West

English Harbour

Northern Cove

Northern Point

Horse Chops

Green Bay

Maiden Point

Wolf Head

Bald Hd

St Jones Head

Harts Head

Kings Head Pond

Winterton

Salvage Point

White Point

Pigeons Pond

Northwest Pond

Rapids

Salmon Pond

Mollygunjeck Lake

Northwest Arm

Clode Sound

Goose Hd

Settlings Pond

Southwest Arm

Otfords Pt

Rocky Pd

Juniper Pds

Dalton Pd

Dam Pd

Matthews Pond

Gull Pond

Big Pond

Thorburn Lake

Georges Pond

Georges Brook

Ryder's Brook

Rocky Pond

Fire Lookout

Muffler Pd

Spar Pd

Cross Pd

Northeast Pond

Midway Pd

Rocky Hbr

Hodge's Cove

Caplin Cove

Islands Pond

Hearts Ease Isle

Little Hearts Ease

Southeast Pond

Bluff Point

Derry Brook

Sweet Harbour Pond

Red Indian Pond

Western Pond

Frost Pond

Island Pond

Tug Pond

Middle Pond

Sweet Harbour

Grimestone

Mills Siding

Fogbird Pond

Bluff Pt

Grandfather Bk

Winter Bk

Southwest Bk

Northwest Bk

Southwest

Northwest

Trans-Canada

Fire

1083 △

852 △

1185 △

717 △

N/A

14 - 17

Ocean Pond

Lady Pond

Rocky Pond

Second Pond

Northeast Pond

Midway Pd

Big Coaker Pond

Blue Gull Pond

Saddle Back Pond

Trouty Pond

Spanserds Cove

Salvage Head

Fox Hd

English Head

Chapmpney's West

English Harbour

Northern Cove

Northern Point

Horse Chops

Green Bay

Maiden Point

Wolf Head

Bald Hd

St Jones Head

Harts Head

Kings Head Pond

Winterton

Salvage Point

White Point

53°45'

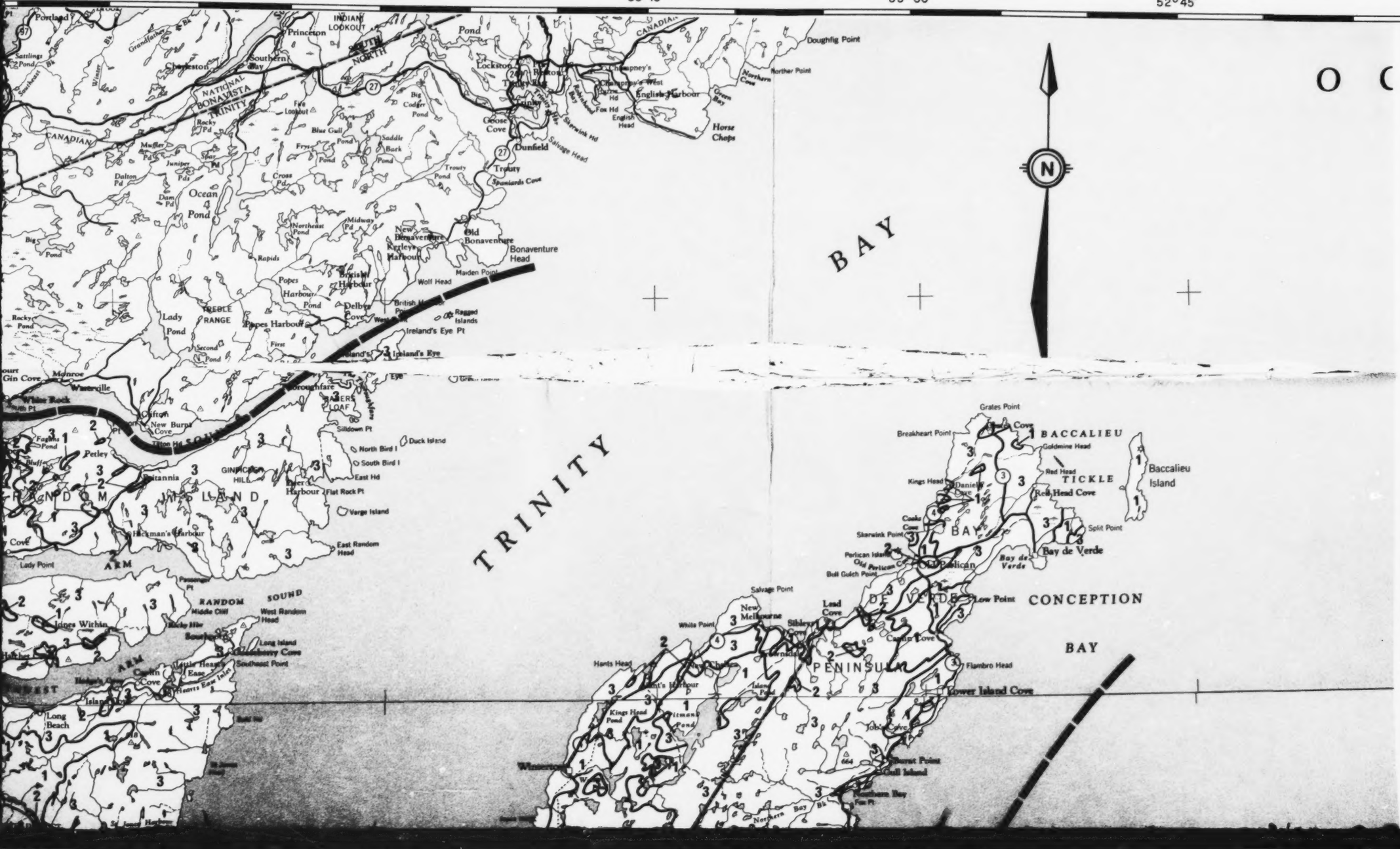
53°30'

53°15'

53°00'

52°45'

52°30'



53°00'

52°45'

52°30'

52°15'

52°00'

51°45'

48°15'

48°00'

Doughfig Point

Norther Point

BAY

N

Grates Point

Breakheart Point

Cove

BACCALIEU

Goldmine Head

Red Head

TICKLE

Baccalieu Island

Kings Head

Daniels Cove

Red Head Cove

Split Point

Cooks Cove

Skerwink Point

BAY

Pelican Island

Old Pelican Cove

Old Pelican

Bay de Verde

Bay de Verde

Bull Gulch Point

Grange Point

New Melbourne

Lead Cove

DE VERDE

Low Point

CONCEPTION

BAY

Stilwell Cove

Carbonear

Cuslett Cove

PENINSULA

Flambro Head

Adams Point

Lower Island Cove

Job's Cove

664

Burnt Point

Gull Island

Northern Bay

Northern Bay Pt

Pinchard Point

Cuslett Cove

LEGEND

1	MORAINE — Includes ground moraine (predominant) and end moraine mainly comprised of well graded, stony, glacial till with silt to gravel sizes; isolated zones of stratified drift; mainly thin and discontinuous; locally, bedrock outcrops may be numerous.
2	GLACIOFLUVIAL — Includes outwash deposits of gravel, sand and silt; outwash valley train and deltaic sediments; kames and kame terraces; mainly well sorted with little silt.
3	BEDROCK — Extensive outcropping or bedrock concealed by thin veneer of topsoil.
N/A	Data on surficial geology not available.

48°00'
47°45'
TRINITY BAY
TRINITY
TERRA NOVA CHANNEL
TRINITY NORTH DISTRICT
PLACENTIA WEST DISTRICT
TRINITY SOUTH DISTRICT
TRINITY NORTH DISTRICT
TRINITY SOUTH DISTRICT
BAIE VERTE DISTRICT
CARBONEAR DISTRICT
HARBOUR GRACE DISTRICT
NORTHWEST ARM
SOUTHWEST ARM
RANDOM SOUND
N/A
Deer Lake
Pond
Lady Cove
Lady Point
Hickman's Harbour
Verge Island
East Random Head
Passenger Pt
Middle Cliff
West Random Head
Southport
Long Island
Gooseberry Cove
Southeast Point
Jones Within
Harbour Deep
North West Brook
Queen's Cove
Hodge's Cove
Captin Cove
Little Heart's Ease
Hearts Ease Islet
Island Hbr
Long Beach
Bald Hd
St Jones Head
St Jones Harbour
North Hd
Deer Harbour Hd
Big I
Thames Harbour Pt
Swift Current
Garden Cove
North Harbour
Goose Cove
Come By Chance
Niagara Pt
Bull I
Sound Island
Brimstone Pt
North Harbour Pt
South Pt
Southern Hd
Come By Chance Pt
Woody Island
Woody Islands
Grass Pt
Bordeaux I
Arnold's Cove
Jacks Pond
Southern Harbour
Ram Hd
Masters Hd
Western Hd
Tickle Harbour Pt
Carroll Pt
Soldier's Cove
Glendon Cove
Bread I
Long Island Pt
White I
Ship I
Spencers Cove
Great Brule
Little Chambers I
Davis Cove
Chambers
Tacks Beach
Bett's Harbour
Dog Harbour Hd
Kingwell
Rose au Rue Pt
Green Hd
Tickle
Bay
Bellevue Beach Provincial Park
Bellevue
Little Harbour East
Little Harbour Hd
Brannon Pt
Pinchgut Cove
Great Pinchgut
Pinchgut Pt
Chance Cove
Thornlea
Collier
Collier Pt
Tickle Harbour
Normans Cove
Chapel Arm
Chapel Hd
McLeod Pt
Dildo
Dildo Arm
Spreadeagle Cove
Spreadeagle Pt
Old Shop
Dildo South
Blaketown
Fair Haven
Hopeall Hd
Salvage Point
New Melbourne
White Point
Hants Head
Kings Head Pond
Winterton
Jeans Hd
Garlep Pt
New Perlican
Souther Pt
Heart's Content
Heart's Delight
Islington
Boar Pt
Gannet Pt
Carbonear
Cavendish
Victoria
Freshwater
Salmon Cove
Harbour Grace
Upper Island Cove
Bishop's Cove
Spaniard's Bay
Shearstown
Foley's
Butterville
Hopeall Head
Whiteway
Ocean Pond
Riverhead
Kelly's Pd
White Hill Pd
Sutton Pd
Long Pd
Gull Pd
Big Island Pd
Rocky Pds
Pinchgut Lake
Pinchgut Lake Pd
Pinchgut Lake Pds
Pinchgut Lake Pds
Pinchgut Lake Pds

1 MORAINE — Includes (predominant) and en comprised of well gra with silt to gravel siz stratified drift; mainl locally, bedrock outcro

2 GLACIOFLUVIAL — Incl of gravel, sand and sil train and deltaic sedim terraces; mainly well s

3 BEDROCK — Extensive concealed by thin vene

N/A Data on surficial geolo

Surficial hydrogeological unit boundary — Approxi

Eskers (in direction of stream flow).

Approximate division of inner and outer drift z

Drilled well location.

DEPARTMENT OF EN
GOVERNMENT OF NEWFOUNDL

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3 BEDROCK — Extensive outcropping or bedrock concealed by thin veneer of topsoil.

N/A Data on surficial geology not available.

Surficial hydrogeological unit boundary — Approximate.

Eskers (in direction of stream flow).

Approximate division of inner and outer drift zone.

Drilled well location.

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

47° 45'

54° 30'

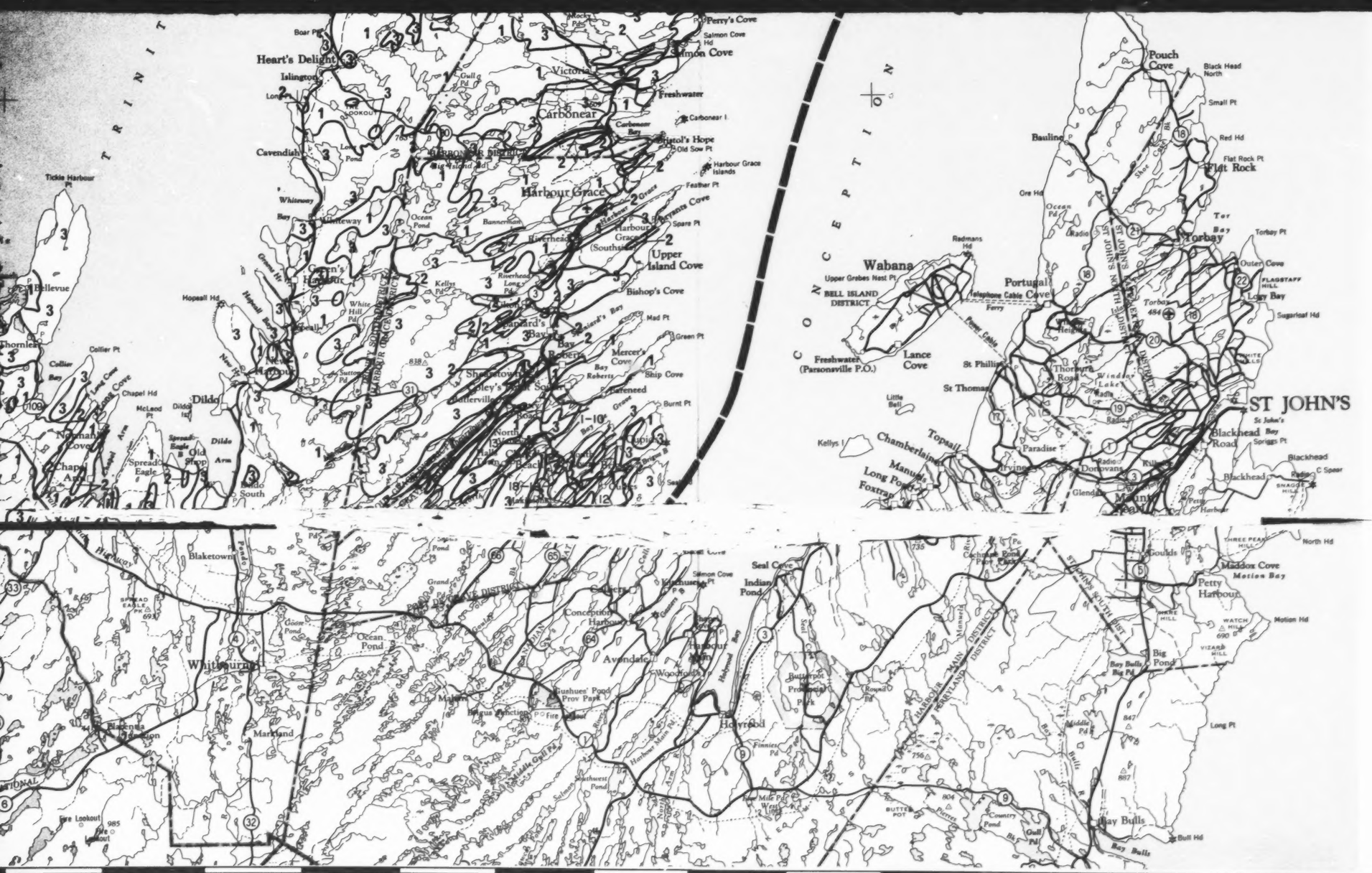
54° 15'

54° 00'

53° 45'

53° 30'

53° 15'



45'

53°30'

53°15'

53°00'

52°45'

52°30'

52°15'

DEPARTMENT O
GOVERNMENT OF NEWFOU

SURFICIAL HY

HYDROGEOLOGY OF

1982

MAP

Scale 1 : 25

5 0 5 10

KILOME

NOLAN, DAVIS & ASS

DEPARTMENT OF ENVIRONMENT
GOVERNMENT OF NEWFOUNDLAND AND LABRADOR

SURFICIAL HYDROGEOLOGY

HYDROGEOLOGY OF TRINITY BAY AREA

1982

MAP 2

Scale 1 : 250,000

5 0 5 10 15 20 25

KILOMETRES

NOLAN, DAVIS & ASSOCIATES LIMITED

54°30' 54°15' 54°00' 53°45' 53°30' 53°15'

48°15'

48°00'

TRINITY

CLODE SOUND

RANDOM SOUND

TRINITY NORTH DISTRICT

TRINITY SOUTH DISTRICT

PLACENTIA WEST DISTRICT

Port Blandford

Musgravetown

Bunyan's Cove

Bloomfield

Brookfield

Portland

Princeton

Southern Bay

Charleston

Indian Lookout South

Indian Lookout North

Pond

Lockston

Trinity

Trinity East

Goose Cove

Dunfield

Trouty

Champney's

Champney's West

English Harbour

Horse Chops

Northern Cove

Norther Point

Old Bonaventure

New Bonaventure

Keeleys Harbour

Bonaventure Head

Maiden Point

Wolf Head

British Harbour

Delbro Cove

Ragged Islands

Ireland's Eye Pt

Ireland's Eye

Anthony Island

Green Island

Ivanhoe

Eye

Broughfare

BAKERS LOAF

Silldown Pt

Duck Island

North Bird I

South Bird I

East Hd

Verge Island

East Random Head

Flat Rock Pt

Fiery Harbour

GINGERBREAD HILLS

Fox Hd

English Head

Skerwink Hd

Salvage Head

Shoreham Cove

Pope's Harbour

Pope's Harbour Pond

Treble Range

Lady Pond

Ocean Pond

Northeast Pond

Midway Pd

Rocky Pond

Second Pond

First Pond

Big Codger Pond

Saddle Back Pond

Blue Gull Pond

Fire Lookout

Rocky Pd

Muffler Pd

Juniper Pds

Spar Pd

Dalton Pd

Dam Pd

Cross Pd

Matthews Pond

Trouty Pond

Frosty Pond

Northwest Pond

Goose Hd

Settlings Pond

Grandfather Bk

Winsor Bk

Southwest Bk

Goose Pt

Offords Pt

Lethbridge

Rapids Brook

Northwest Arm

Northwest Bk

Salmon Bk

Salmon Pond

Pinsents Pond

Mollyguajeck Lake

Rapids

717 △

Northwest Pond

Southwest

Thorburn Lake

Gull Pond

Big Pond

Georges Pond

Georges Brook

Ryders Brook

Trans-Canada Highway

Milton

Mills Siding

Grimes Cove Hd

Barton

Harcourt

Gin Cove

Monroe

Winterville

White Rock

Clarenville

Clarenville South

Snooks Harbour

Aspey Brook

Fagans Pond

Bluff Point

Weybridge

Lady Cove

Lady Point

Southwest Arm

Random Island

Random Sound

Passage Pt

Middle Cliff

West Random Head

Long Island

Blackberry Cove

Blackberry Point

Little Heart's Ease

Heart's Ease

Heart's Content

Castle Cove

Hodge's Cove

Island Cove

Long Beach

Hillview

Hatchet Cove

North West Brook

Gunn's Cove

St Jones Within

Deep Bight

Shoal Harbour Pond

Shoal Harbour

Red Indian Pond

Western Pond

Frost Pond

Island Pond

Sleigh Pond

Radio

Trap Pond

Middle Pond

Newmans Pond

Whitehead

Pilleys Island

Hodges Pond

Rapids

1108 △

1114 △

852

1083 △ Fire

Southwest

Northwest

Middle

Red

Shoal

Deep

Gunn's

Hodge's

Island

Long

Random

Southwest Arm

Northwest Arm

Southwest Bk

Northwest Bk

Salmon Bk

Rapids Brook

Ryders Brook

Georges

53°45' 53°30' 53°15' 53°00' 52°45' 52°30' 52°15'

TRINITY BAY

CONCEPTION BAY

PENINSULA

DE VERDE

TICKLE BAY

BAKERS BROUGHFARE

RANDOM SOUND

Princeton
INDIAN LOOKOUT
Southern Bay
Charleston
NATIONAL BONAVISTA TRINITY
Fire Lookout
Big Codger Pond
Blue Gull Pond
Saddle Back Pond
Trouty Pond
Cross Pd
Ocean Pond
Northeast Pond
Midway Pd
Rapids
Pope's Harbour Pond
Lady Pond
TREBLE RANGE
Pope's Harbour
Delbra Cove
Ireland's Eye Pt
Ragged Islands
Ireland's Eye
Anthony Island
Green Island
Duck Island
North Bird I
South Bird I
East Hd
Flat Rock Pt
Varga Island
East Random Head
Siltdown Pt
Clifton
New Burnt Cove
Masterville
GINGER HILL
Fisher's Harbour
Pond
Lockston
Trouty
Trinity
Goose Cove
Dunfield
Trouty
Spaniards Cove
Old Bonaventure
New Bonaventure
Kerley's Harbour
Bonaventure Head
Maiden Point
Wolf Head
British Harbour
Salvage Head
Sherwink Hd
Fox Hd
English Head
Chapmpey's
Chapmpey's West
English Harbour
Doughfig Point
Northern Cove
Norther Point
Green Bay
Horse Chops
Grates Point
Breakheart Point
Goldmine Head
Red Head
Head Cove
Baccalieu Island
Split Point
Kings Head
Daniel's Cove
Cuckolds Cove
Sherwink Point
Pelican Island
Old Perlican Cove
Butt Gulch Point
Old Perlican
Bay de Verde
Salvage Point
New Melbourne
Lead Cove
White Point
Caplin Cove
Flambro Head
Harts Head
Hunt's Harbour
Brownsdale
Island Pond
Kings Head Pond
Pitman's Pond
Western Pond
Job's Cove
Grates Point
Breakheart Point
Goldmine Head
Red Head
Head Cove
Baccalieu Island
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Flambro Head
Harts Head
Hunt's Harbour
Brownsdale
Island Pond
Kings Head Pond
Pitman's Pond
Western Pond
Job's Cove

1 Low yi… gpm) … gpm). … 4·5 ipm

2 Moder… ipm (5… (0·25 … unit yi… greate…

3 Compo… yield … 13·6 – … wells … have …

4 Co… yield …

53°00'

52°45'

52°30'

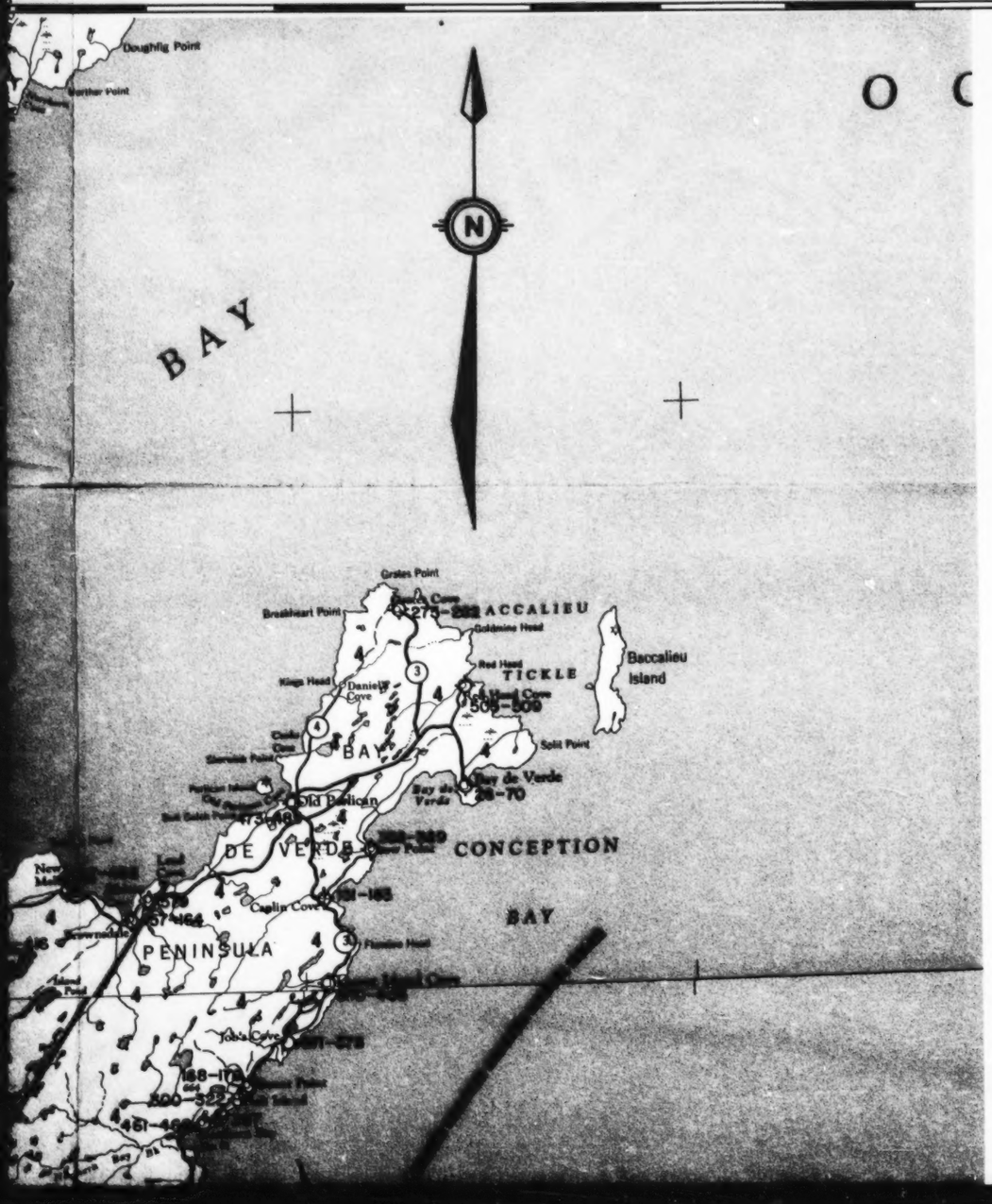
52°15'

52°00'

51°45'

48°15'

48°00'



LEGEND

1	Low yielding unit. Mean yield of 10·0 lpm (2·2 gpm) with a range of 1·1 – 38·6 lpm (0·25 – 8·5 gpm). 50% of the wells in this unit yield 0 – 4·5 lpm, none have yields greater than 45·0 lpm.
2	Moderately productive unit. Mean yield of 23·2 lpm (5·1 gpm) with a range of 2·3 – 295·5 lpm (0·25 – 65·0 gpm). 23·7 % of the wells in this unit yield 0 – 4·5 lpm, 8·8 % have yields greater than 45·0 lpm.
3	Comparatively, a highly productive unit. Mean yield of 29·5 lpm (6·5 gpm) with a range of 13·6 – 68·2 lpm (3·0 – 15·0 gpm). None of the wells in this unit yield 0 – 4·5 lpm, 33·3 % have yields greater than 45·0 lpm.
4	Comparatively, the most productive unit. Mean yield of 33·2 lpm (7·3 gpm) with a range of 2·3 – 454·6 lpm (0·5 – 100·0 gpm). 7·6 % of the wells in this unit yield 0–4·5 lpm,

48° 00'

47° 45'

TRINITY BAY

TRINITY BAY

N/C

Verge Island

East Random Head

Weybridge

Lady Cove

Lady Point

Passage Pt

RANDOM SOUND

Middle Cliff

West Random Head

Long Island

Blueberry Cove

Point

Salvage Point

New Melbourne

White Point

Brownsdale

Hants Head

Kings Head Pond

Pitman Pond

Island Pond

Winterton

Western Pond

Jeans Hd

Garlop Pt

New Perlican

Southern Pt

Heart's Content

Western Pond

Adams Cove

Kingston

SHUFFLE BOARD

Heart's Desire

Gannet Pt

HANGING HILL

Seal Cove Pd

Boar Pt

Heart's Delight

Islington

Long Pt

THE LOOKOUT

Victoria

Carbonear

Carbonear I.

Cavendish

Whiteway

Bay

Ocean Pond

Harbour Grace

Harbour Grace (Southside)

Riverhead

Upper Island Cove

Green's Harbour

Kelligrews Pd

Tilton

Spaniard's Bay

Hopeall Hd

New Harbour

Shearstown

Coley's Pd

Butlerville

Dildo

Dildo South

Old Shop

Spread Eagle

Chapel Arm

Norman's Cove

Long Cove

Chapel Hd

McLeod

Collier Pt

Collier Bay

Thorne

Tickle Harbour

Tickle Pt

Fair Haven Pt

Fair Haven

Tickle Harbour Pt

Tickle

Bay Bellevue Beach Provincial Park

Bellevue

DOE HILLS

Chance Cove

SERRATED HILL

Western Hd

Masters Hd

Ram Hd

Bull I

Arnold's Cove Stn

Jokes Pond Prov Park

Great Southern Hr

Southern Harbour

Grassy Pt

Bordeaux I

Bread I

Long Island Pt

White I

Spencer Cove

Wharf

Great Brule

CROWICK HILLS

Wharves

Davis Cove

Little Chambers I

Chambers

Greap Hd

Tacks Beach

Bear's Harbour

Dog Harbour Hd

Kingwell

Rose au Rue Pt

Rose au Rue

Barrys

Harbour Buffett

KEARNEY HD

Monkstown

Woody Island

Woody Islands

Sound Island

Sound Island Pt

Brimstone Pt

North Harbour Pt

South Pt

Southern Hd

Come By Chance Pt

Come By Chance

Sunnyside

Gardiner's Cove

North Harbour

Soldier's Cove

Glendon Cove

Carroll Pt

Ship I

Little Harbour East

Brennan Pt

Pinchgut Pt

Great Pinchgut

Little Harbour

Tickle Harbour

Niagara Pt

Thames Harbour Pt

Deer Harbour Hd

Big I

North Hd

St Jones Harbour

St Jones Head

Bald Hd

Long Beach

Hodge's Cove

Captin Cove

Queen's Cove

North West Brook

Hillview

Heytown

St James Within

Southport

Harbour Cove

Little Harbour East

Island Cove

Deep Bight

Radio

Sleigh Pond

Island Pond

Red Indian Pond

Western Pond

Frost Pond

Tent Pond

Goose Pond

Rapids

Long Pond

Toby Lookout

Grip Ness

White Hills

Pearce Hd

Soldier's Cove

Carbonear Island

Harbour Islands

Fresh Water

Salmon Cove

Salmon Cove Hd

Victoria

Whiteway

Bannerman I

Riverhead

Kelligrews

Tilton

Spaniard's Bay

Shearstown

Coley's Pd

Butlerville

Dildo

Dildo South

Old Shop

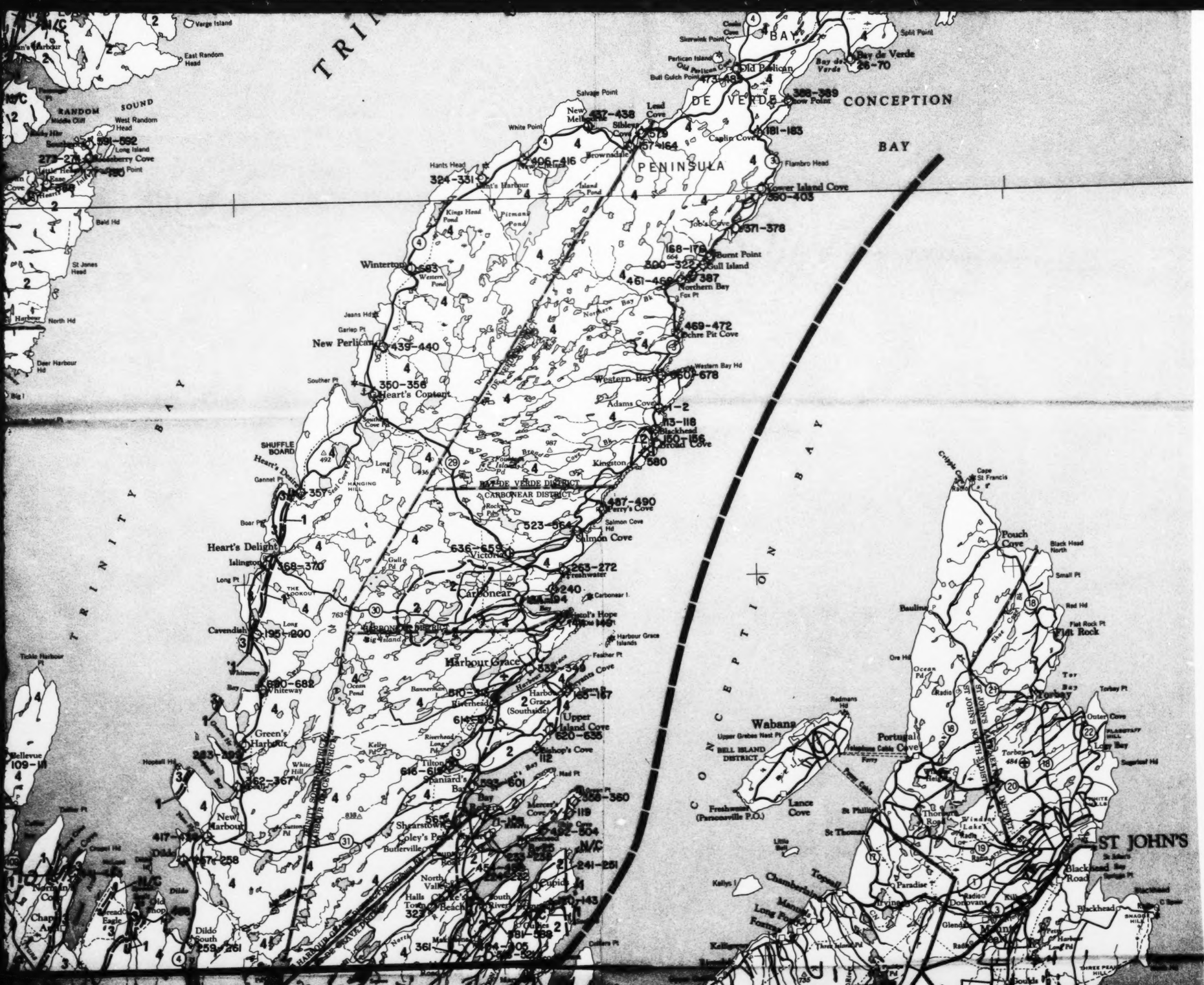
Spread Eagle

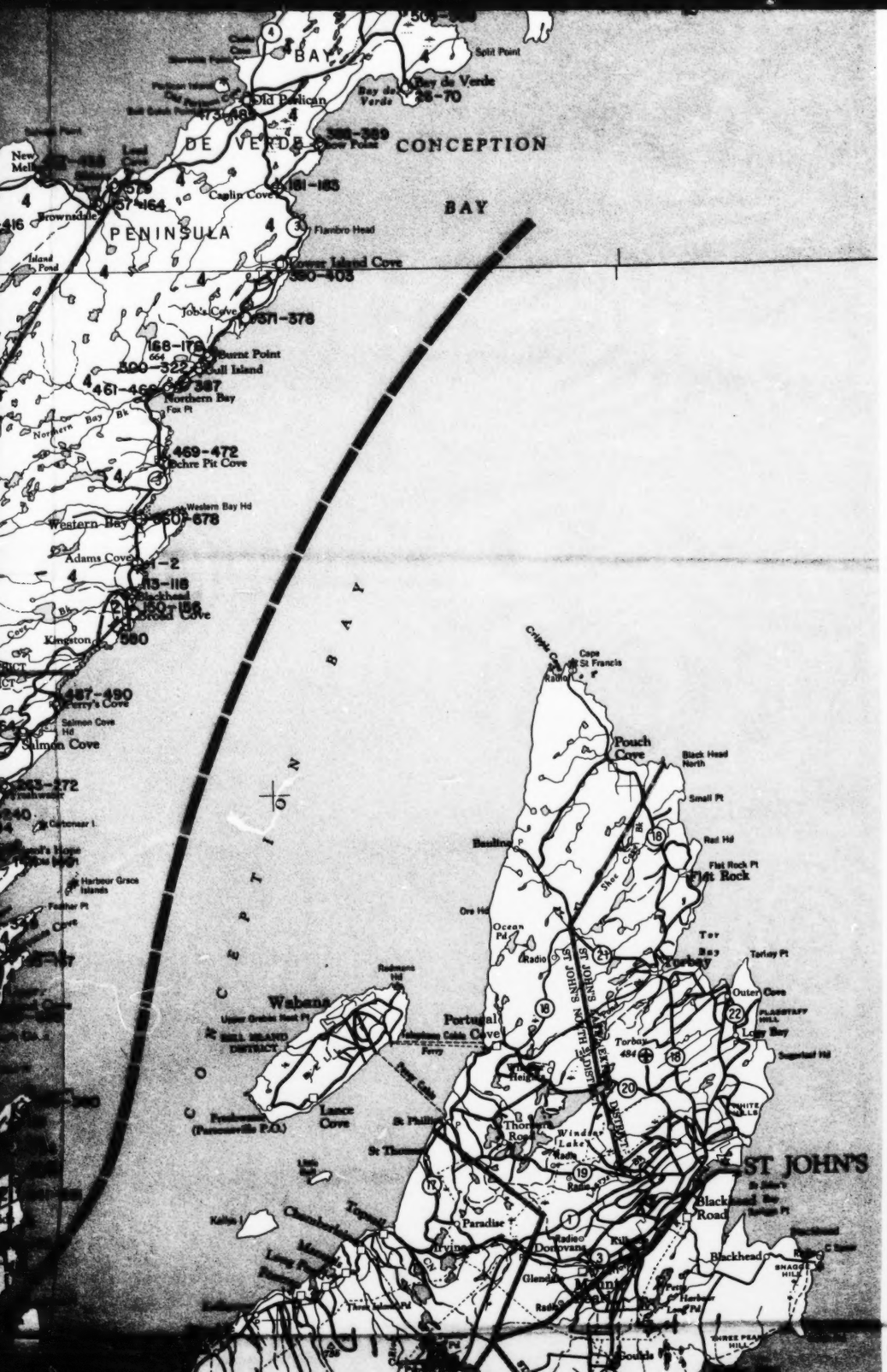
Chapel Arm

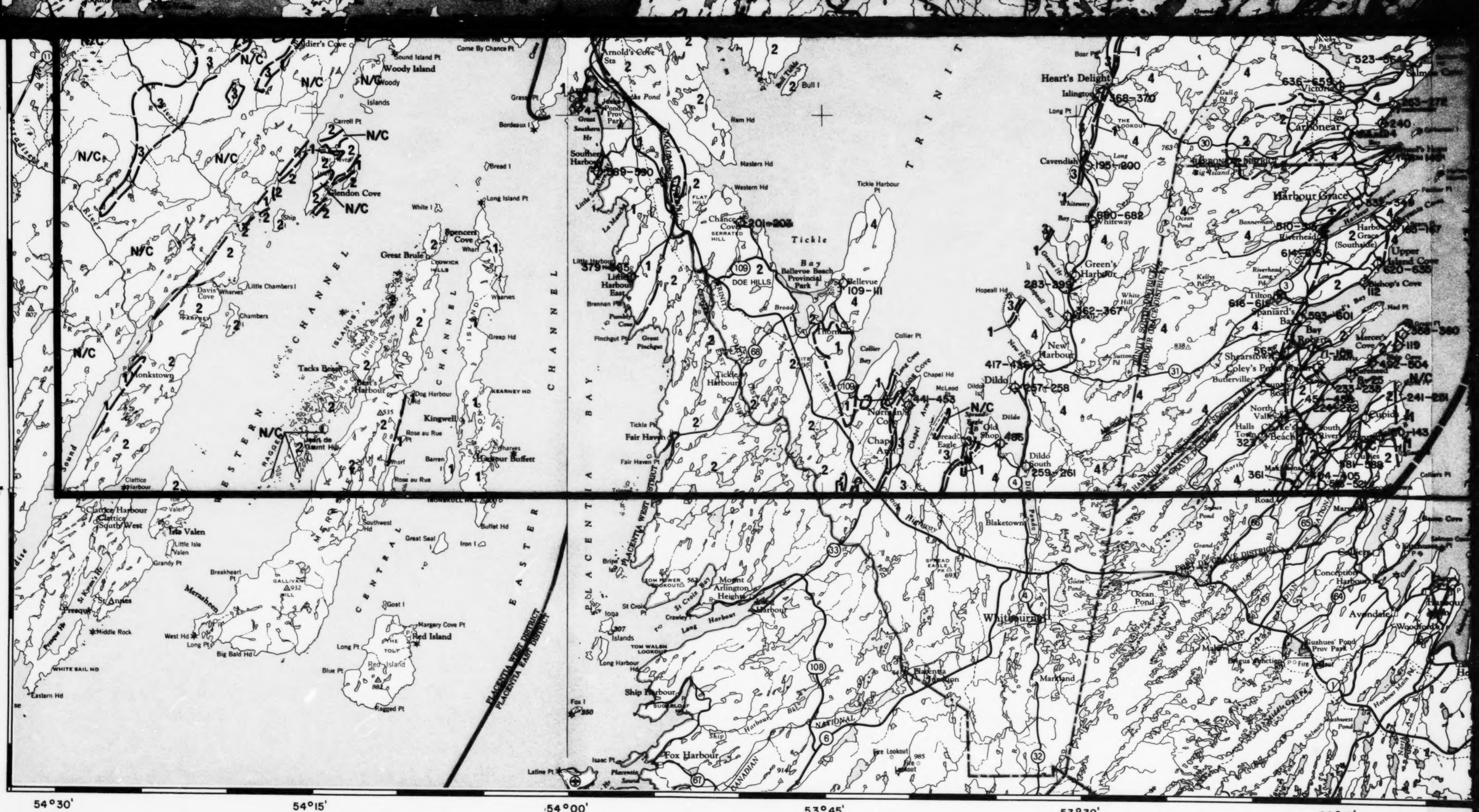
Norman's Cove

Long Cove

Chapel Hd


TRINITY BAY
CONCEPTION BAY
PENINSULA
DE VERDE
BAY
RANDOM SOUND
Varge Island
East Random Head
West Random Head
Middle Cliff
Long Island
Bald Hd
St Jones Head
North Hd
Deer Harbour Hd
Big I
Split Point
Bay de Verde
Old Perlican
Salvage Point
New Melbourne
Lead Cove
Sibleys Cove
White Point
Caplin Cove
Flambro Head
Hants Harbour
Brownsdale
Island Pond
Kings Head Pond
Pitmans Pond
Tower Island Cove
Job's Cove
Burnt Point
Gull Island
Northern Bay
Fox Pt
Ochre Pit Cove
Western Bay Hd
Adams Cove
Blackhead
Broad Cove
Kingston
Wintertown
Western Pond
Jeans Hd
Garlep Pt
New Perlican
Souther Pt
Heart's Content
Southern Cove Pd
SHUFFLE BOARD
Heart's Desire
Gannet Pt
Seal Cove Pd
HANGING HILL
Boar Pt
Heart's Delight
Islington
Long Pt
THE LOOKOUT
Cavendish
Whiteway
Ocean Pond
Tickle Harbour Pt
Bellevue
Hospell Hill
White Hill
New Harbour
Dildo
Dildo South
Green's Harbour
Kelly Pd
Tilton
Spaniard's Bay
Shearstown
Coley's Pt
Butterville
North Valley
Halls Town
Victoria
Gull Pd
Carbonear
Carbonear I.
Mosquito Pond
Big Island
Harbour Grace
Harbour Grace Islands
Feaher Pt
Bonnerss Cove
Riverhead
Harbour Grace (Southside)
Upper Island Cove
Bishop's Cove
Mad Pt
Mercer's Cove
Cupids
Freshwater
Salmon Cove
Salmon Cove Hd
Perry's Cove
Broad Cove
Blackhead
Adams Cove
Western Bay
Northern Bay
Burnt Point
Job's Cove
Tower Island Cove
Flambro Head
Caplin Cove
Lead Cove
New Melbourne
Old Perlican
Bay de Verde
Split Point
Pouch Cove
Black Head North
Small Pt
Red Hd
Flat Rock Pt
Flat Rock
Torbay
Torbay Pt
Outer Cove
Logy Bay
Signal Hill
Redmans Hd
Wabana
Upper Grabes Nest Pt
BELL ISLAND DISTRICT
Freshwater (Parsonsville P.O.)
Lance Cove
Portugal Cove
Telephone Cable Ferry
St Phillips
St Thomas
Thorburn Road
Windsor Lake
Paradise
Topsail
Chamberlains
Kellys I
Little Bell I
Long Pond
Foxtrap
Kelligrews
Three Island Pd
Bauline
Ore Hd
Ocean Pd
Radio
ST JOHN'S NORTH DISTRICT
ST JOHN'S
Blackhead Road
Donovans
Glendale
Mount Pearl
Harbour Grace Pd
Cape St Francis
Radio
Crippl Cove
Pouch Cove
Black Head North
Small Pt
Red Hd
Flat Rock Pt
Flat Rock
Torbay
Torbay Pt
Outer Cove
Logy Bay
Signal Hill
Blackhead
Blackhead Road
Donovans
Glendale
Mount Pearl
Three Pearls Hill
Kelligrews
Foxtrap
Long Pond
Topsail
Paradise
Chamberlains
Kellys I
Little Bell I
St Thomas
St Phillips
Thorburn Road
Windsor Lake
Portugal Cove
Telephone Cable Ferry
Lance Cove
Freshwater (Parsonsville P.O.)
Upper Grabes Nest Pt
BELL ISLAND DISTRICT
Wabana
Redmans Hd
Bauline
Ore Hd
Ocean Pd
Radio
ST JOHN'S NORTH DISTRICT
ST JOHN'S
Blackhead Road
Donovans
Glendale
Mount Pearl
Harbour Grace Pd


BAY
DE VERDE
CONCEPTION
BAY
PENINSULA
Split Point
Old Pelican
Bay de Verde
Caplin Cove
Flambro Head
Tower Island Cove
Job's Cove
Burnt Point
Gull Island
Northern Bay
Fox Pt
Ochre Pit Cove
Western Bay Hd
Western Bay
Adams Cove
Blackhead
Kingston
Salmon Cove
Cape St Francis
Pouch Cove
Black Head North
Small Pt
Red Hd
Flat Rock Pt
Flat Rock
Bauline
Ore Hd
Ocean Pd
Radio
Torbay
Torbay Pt
Outer Cove
Logy Bay
Wabana
Portugal Cove
Lance Cove
Pennywise (Pennywise P.O.)
St. Phillips
Thorburn Road
Windsor Lake
ST JOHN'S
Blackhead Road
Paradise
Irving
Donovans
Glendale
Mount Pearl
Goulds
Kelligrews
Topsail
Chamberlains
Long Pond
Thorburn Lake
Harbour Grace Islands
Foxtrap Pt
Island Pond
Brownsdale
New Melbourne
Land Cove
Caplin Cove
Tower Island Cove
Job's Cove
Burnt Point
Gull Island
Northern Bay
Fox Pt
Ochre Pit Cove
Western Bay Hd
Adams Cove
Blackhead
Kingston
Salmon Cove
Split Point
Old Pelican
Bay de Verde
Flambro Head


47° 45'
47° 30'
54°30'
54°15'
54°00'
53°45'
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Soldier's Cove
Woody Island
Woody Islands
Carroll Pt
Glendon Cove
Bread I
Long Island Pt
White I
Spencers Cove
Great Brule
Little Chambers I
Davis Cove
Wharves
Chambers
Tacks Beach
Bear's Harbour
Dog Harbour
Kingwell
Rose au Rue Pt
Harbour Buffett
Greep Hd
Arnold's Cove Sta
Come By Chance Pt
Grassy Pt
Bordeaux I
Southern Harbour
Ram Hd
Masters Hd
Western Hd
Tickle Harbour Pt
Chance Cove
Little Harbour East
Brennan Pt
Pinchgut Pt
Great Pinchgut
Bellevue Beach Provincial Park
Bellevue
Thornhill
Collier Pt
Collier Bay
Long Cove
Chapel Hd
McLeod
Tickle Harbour
Tickle Pt
Fair Haven Pt
Northern Cove
Chapel Arm
Dildo
Dildo Pond
Old Shop
Spread Eagle
Heart's Delight
Islington
Long Pt
Cavendish
Whiteway
Ocean Pond
Green's Harbour
Hopeall Hd
New Harbour
Carbonear
Harbour Grace
Harbour Grace (Southside)
Riverhead
Upper Island Cove
Bishop's Cove
Tilton
Spaniard's Bay
Shearstown
Coley's Point
Butterville
Mercer's Cove
Cupids
North Valley
Halls Bay
Clarke's Beach
South River
Marysvale
Road
Salmon Cove
Victoria
Blaketown
Whitbourne
Markland
Placentia Junction
Mount Arlington Heights
Harbour
Crawley's
Long Harbour
Ship Harbour
Fox Harbour
Fox I
Isaac Pt
Latine Pt
Placentia Sound
Iona
St Croix
St Croix Bay
Bripe I
Tom Power Lookout
Tom Walsh Lookout
Fire Lookout
Conception Harbour
Avondale
Woodlands
Bushues' Pond Prov Park
Margaret's Bay
Salmonier
Colliers
Colliers Pt
Harbour Main Pt
Isle Valen
Little Isle Valen
Grandy Pt
Clattice Harbour
Clattice Harbour South West
Clattice Pt
Presque
St Annies
Middle Rock
Eastern Hd
WHITE SAIL HD
Breakheart Pt
Merasheen
West Hd
Long Pt
Big Bald Hd
GALLIVAN HILL 932
Goat I
Margery Cove Pt
Red Island
Red Island
Blue Pt
Ragged Pt
Southwest Hd
Great Seal
Iron I
Buffet Hd
IRONBOUND HILL
Sound Island Pt
Ship
Davis River
Tickle Bay
Placentia West District
Placentia East District
Placentia West-Bay de Verde District
Harbour Grace District
Grave District
Trinity
Bay
Western Channel
Central Channel
Eastern Channel
Islands
Trans-Canada Highway
Canadian
National
Fire Lookout
985
914
807
535
881
932
907
850
Fire
P.O.

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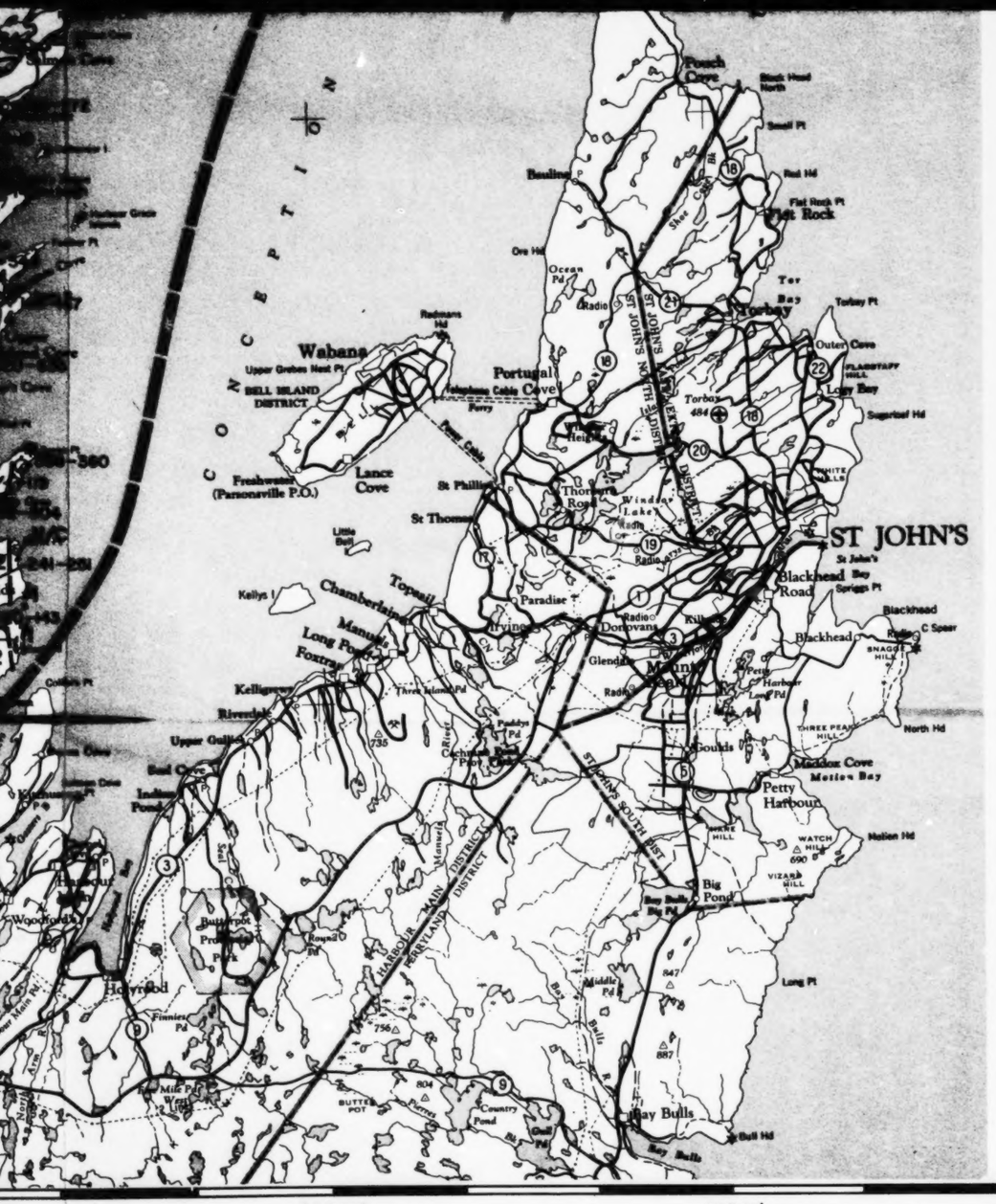
CONCEPTION
Pouch Cove
Flat Rock
Torbay
Wabana
Bell Island District
Portugal Cove
Freshwater (Parsonsville P.O.)
Lance Cove
St Phillips
St Thomas
Thorburn Road
Windsor Lake
ST JOHN'S
Blackhead Road
Paradise
Chamberlains
Topsail
Kelligrews
Riverhead
Upper Gullies
Seal Cove
Holyrood
Bauline
Ocean Pd
Outer Cove
Logy Bay
Blackhead
C Spear
Goulds
Petty Harbour
Middle Cove
Motion Bay
Big Pond
Bay Bulls
Bull Hd
North Hd
Long Pt
Three Peak Hill
Watch Hill
Vizard Hill
Snagger Hill
St John's North Eastern District
St John's South Western District
Harbour Main District
Petty Harbour Land Dist
Stinking South West
Conception Bay Main District
Avalon Peninsula Main District
Telephone Cable Ferry
Ferry Cable
Radio
Radio Aerial
Windsor Lake
Torbay 484
Three Islands Pd
Paddys Pd
Cochrane Pond
Kelligrews Pond
Indian Pond
Scal Pond
Butterpot Provincial Park
Butterpot Pond
Country Pond
Gull Pd
Big Pond
Bay Bulls Big Pd
Middle Pd
Finnies Pd
Mine Pd
Woodford's
Mount Pearl
Glendale
Kilbride
Donovans
Irvings
Kellys
Little Bell I
Rocky Pt
Small Pt
Red Hd
Flat Rock Pt
Ore Hd
Torbay Pt
Sugarloaf Hd
Flagstaff Hill
White Hills
Scrips Pt
St John's
Radio Donovans
Radio Aerial
Petty Harbour Land Pd
Bay Bulls
Bull Hd
Middle Pd
Long Pt
Motion Hd
Middle Cove
Goulds
North Hd
Blackhead
C Spear
Snagger Hill
Three Peak Hill
Watch Hill
Vizard Hill
Big Pond
Bay Bulls Big Pd
Butterpot Provincial Park
Butterpot Pond
Country Pond
Gull